

SITE-SPECIFIC BACKGROUND SOIL CONCENTRATION CALCULATIONS US OIL RECOVERY SUPERFUND SITE

Introduction

This focused report provides the results of a study conducted to estimate representative site-specific background soil concentrations for metals, semi-volatile organic compounds (SVOCs) (including polycyclic aromatic hydrocarbons (PAHs)), pesticides, and herbicides for the US Oil Recovery Superfund Site (USOR) in Pasadena, Texas (the Site). In part, representative site-specific background soil concentrations will be used to evaluate the nature and extent of contamination at the Site during the Remedial Investigation (RI) and to assist in the development and evaluation of remedial alternatives during the Feasibility Study (FS). The representative site-specific background soil concentrations will not be used for screening purposes in either the Baseline Human Health Risk Assessment (BHHRA) or the Screening Level Ecological Risk Assessment (SLERA). The background soil sampling was conducted in accordance with Work Plan Refinement/Modification Notice (WRN) No. AO1-1-3, dated October 11, 2016 and accepted by EPA on October 12, 2016 (PBW, 2016). To evaluate anthropogenic background conditions in the Site vicinity, soil samples were collected from two non-tidally influenced locations and one tidally-influenced location, both within one mile of the Site. The methodology used to develop representative background soil concentrations from the sample analytical data is based on EPA guidance (EPA, 2000; EPA, 2002; EPA, 2009; EPA, 2017), and standard statistical procedures. The methodology, associated rationale, and results of the analysis are outlined below.

Background Soil Sampling

Background soil sampling was performed at two areas (Figures 1 and 2) in accordance with WRN AOI-1-3. Both locations have characteristics similar to the USOR site. The (b) (6) Background Location (Figure 1) is located at the southwest corner of (b) (6) (b) (6) in Pasadena and is adjacent to Vince Bayou. Only non-tidally influenced samples were collected from the (b) (6) Background Location due to access issues in the

tidally-influenced area at this location. The (b) (6) Background Location (Figure 2) is located south of (b) (6) and east of (b) (6), adjacent to Vince Bayou. Samples were collected from both tidally and non-tidally influenced areas at the (b) (6) Background Location.

At the (b) (6) Background Location, soil samples were collected from 10 sample locations within the non-tidally influenced area. At the (b) (6) Location, samples were collected from 10 sample locations from the non-tidally influenced area and from 10 sample locations from the tidally influenced area. At each sample location, soil samples were collected from the 0-0.5 feet and 1-2 feet below ground surface (feet bgs) intervals. Samples were collected using hand tools and in accordance with the approved RI/FS Work Plan (PBW, 2015a). The soil samples were analyzed by ALS laboratory of Houston, Texas for the following constituent groups: 1) metals (using EPA methods SW6020 and SW7471A); 2) SVOCs (EPA method SW8270); 3) pesticides (EPA method SW8081); and 4) herbicides (EPA method SW8151). The specific analytes measured for each constituent group were in accordance with the analyte lists specified in the approved Quality Assurance Project Plan (QAPP) (PBW, 2015b) for those groups of compounds. All methods for sample collection, processing, shipment, etc. were in accordance with the RI/FS Work Plan, Field Sampling Plan (FSP), and QAPP.

Data Preparation

The final laboratory data packages were initially reviewed for usability per the QAPP (PBW, 2015b). The data for each constituent group were then prepared for statistical analysis, as follows. First, field duplicate data (with the primary sample being retained) and data rejected after data validation were removed from the data set. Three sample concentrations were rejected as a result of data validation for the background soil data set. Benzaldehyde, hexachlorocyclopentadiene, and 4-nitrophenol data were rejected for the field sample BGSB10-(1.0-2.0)-161122 because the matrix spike/matrix spike duplicate (MS/MSD) recoveries were less than 10%.

Non-detect concentrations were then handled using EPA guidelines (EPA, 2000; EPA, 2009). Specifically, non-detects were handled by one of two approaches depending on the percentage of detected concentrations, as follows:

- If a constituent was detected in at least 85% of the samples, a simple substitution method was used in which the sample detection limit was substituted as a proxy concentration (EPA, 2000; EPA, 2009).
- If a constituent was detected in more than 60% of the samples, but no more than 85% of the samples, the Robust Regression Order Statistics (RROS) method was used to estimate summary statistics such as the mean and standard deviation (EPA, 2009).

If the constituent was detected in 60% or fewer of the samples, non-detects were handled by using nonparametric statistical approaches to evaluate the data and to prepare summary statistics. Although nonparametric approaches are typically used when there are fewer than 50% detected concentrations (EPA, 2009; EPA, 2000), based on a review of the USOR background data set and professional judgment, a more conservative approach using a 60% threshold was implemented. Using this approach, statistical tests and summary statistics were not artificially influenced by the type of adjustments made for non-detect concentrations.

Data Grouping

After the data were prepared as described above, data were grouped into specific datasets based on the data characteristics using the process shown in Figure 3. To evaluate whether data groups for each constituent were statistically similar, statistical comparisons between population means were performed. Consistent with EPA and other guidance (EPA, 2000; EPA, 2002; EPA, 2009; EPA, 2017; SWDIV, 1998), the comparisons used the two-sample, two-sided hypothesis testing approach. For each constituent, data sets were considered similar if results from the comparison indicated that there was no statistically significant difference in mean concentrations between the data sets and were therefore combined. This was done because more powerful site-to-background comparisons can be performed when the number of background samples increases, which can be achieved by combining data sets from multiple statistically similar background areas.

For each constituent, the first comparison was between the samples from tidally-influenced locations and the samples from non-tidally influenced locations. The second comparison was between the samples collected from the surface soil (0-0.5 ft bgs) interval and the samples collected from the shallow soil (1-2 ft bgs) interval. Based on results from these comparisons, data for each constituent were combined across every grouping (i.e., across the tidally-

influenced and non-tidally-influenced samples; and the surface soil and shallow soil samples) or were separated into one of four groups:

- Tidally-influenced, surface soil samples;
- Tidally-influenced, shallow soil samples;
- Non tidally-influenced, surface soil samples; and
- Non tidally-influenced, shallow soil samples.

The grouping(s) for each constituent are noted on Table 1. Additional detail about the data grouping comparisons is provided in Attachment A.

Identifying Outliers

Once the data were grouped according to the procedure described above, each data group was evaluated for statistical outliers. According to EPA guidelines, statistical outliers are “measurements (usually larger or smaller than other data values) that are not representative of the sample population from which they were drawn” (EPA, 2002). Statistical outliers may distort estimates of background concentrations, therefore they should be identified and potentially removed (EPA, 2017). EPA guidelines (EPA, 2009) generally do not recommend removing statistical outliers “...unless some basis for a likely error or discrepancy can be identified. Such possible errors or discrepancies could include data recording errors, unusual sampling and laboratory procedures or conditions ...and values significantly outside the historical ranges of background data”.

For the purposes of this soil background study, an evaluation for potential statistical outliers was performed for data groups with more than 60% detected concentrations. Statistical outlier tests were performed to check whether any potential outlier may also be defined as an outlier from a statistical point of view. A potential outlier that was also identified as an outlier from a statistical test was evaluated for possible errors or data discrepancies before the representative background concentration was calculated. However, no field or laboratory errors, discrepancies, or conditions were identified. Therefore, no detected concentrations were removed. Attachment B provides more detail about how potential outliers were identified and how outlier tests were performed.

Calculating Background Concentrations

The data distribution for each constituent was defined in accordance with EPA and other guidance (EPA, 2000; EPA, 2002; EPA, 2009; EPA, 2017; SWDIV, 1998). Figure 4 illustrates the steps used to define whether a data group with more than 60% of detected results follows a normal, gamma (restricted to data with at least 85% detected concentrations), lognormal, or nonparametric distribution. The data distribution was tested using a number of distributional tests including the Shapiro-Wilks test, Kolmogorov-Smirnov Test, probability plot correlation coefficient (PPCC) test, and Anderson-Darling test. If none of the distributional tests suggested the data's distribution could be defined as normal, lognormal, or gamma, the distribution was defined as nonparametric. For any data group with 60% or fewer detected concentrations, the data distribution was defined as nonparametric (EPA, 2009), and will not be used in nature and extent evaluations.

Upper tolerance limits (UTLs) were then calculated for each data group using the defined data distribution (see Table 1 for UTLs and Attachment C for calculation details). Representative background concentrations, as indicated in Table 1, were identified as the higher of the UTL and the Texas-specific soil background concentration (per 30 TAC 350.51(m)) for each constituent.

References

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TABLE

Table 1
Representative Background Concentrations Summary
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Site-Specific Background Concentration (mg/kg)	Texas-Specific Soil Background Concentrations ⁽¹⁾ (mg/kg)	Representative Background Concentration ⁽²⁾ (mg/kg)	Comment
Aluminum	Surface soil (0-0.5 feet) samples	13,100	30,000	30,000	Gamma UTL
Aluminum	Shallow soil (1-2 feet) samples	19,600	30,000	30,000	Normal UTL
Antimony	All samples	0.636	1	1	Nonparametric UTL ⁽³⁾
Arsenic	Surface soil (0-0.5 feet) samples	7.97	5.9	7.97	Gamma UTL
Arsenic	Shallow soil (1-2 feet) samples	30.4	5.9	30.4	Nonparametric UTL
Barium	Surface soil (0-0.5 feet) samples	205	300	300	Gamma UTL
Barium	Shallow soil (1-2 feet) samples	243	300	300	Normal UTL
Beryllium	Surface soil (0-0.5 feet) samples	0.985	1.5	1.5	Gamma UTL
Beryllium	Shallow soil (1-2 feet) samples	1.53	1.5	1.53	Normal UTL
Boron	Surface soil (0-0.5 feet) samples	6.05	30	30	Normal UTL
Boron	Shallow soil (1-2 feet) samples	6.71	30	30	Normal UTL
Cadmium	All samples	0.775	1	1	Gamma UTL
Chromium	Surface soil (0-0.5 feet) samples	21.3	30	30	Normal UTL
Chromium	Shallow soil (1-2 feet) samples	24.6	30	30	Normal UTL
Cobalt	Surface soil (0-0.5 feet) samples	36.1	7	36.1	Nonparametric UTL
Cobalt	Shallow soil (1-2 feet) samples	16.1	7	16.1	Gamma UTL
Copper	Tidal Influence samples	76.2	15	76.2	Gamma UTL
Copper	No Tidal Influence samples	31.7	15	31.7	Gamma UTL
Lead	All samples	151	15	151	Gamma UTL
Manganese	Surface soil (0-0.5 feet) samples	609	300	609	Gamma UTL
Manganese	Shallow soil (1-2 feet) samples	783	300	783	Gamma UTL
Mercury	All samples	0.191	0.04	0.191	Gamma UTL
Nickel	Surface soil (0-0.5 feet) samples	17.8	10	17.8	Normal UTL
Nickel	Shallow soil (1-2 feet) samples	18.6	10	18.6	Normal UTL
Selenium	Tidal Influence Surface soil (0-0.5 feet) samples	0.58	0.3	0.58	Normal UTL
Selenium	Tidal Influence Shallow soil (1-2 feet) samples	0.735	0.3	0.735	Normal UTL
Selenium	No Tidal Influence Surface soil (0-0.5 feet) samples	0.679	0.3	0.679	Normal UTL
Selenium	No Tidal Influence Shallow soil (1-2 feet) samples	1.04	0.3	1.04	Normal UTL
Silver	Tidal Influence samples	0.854	1	1	Normal UTL
Silver	No Tidal Influence samples	0.647	1	1	Nonparametric UTL ⁽³⁾
Thallium	Tidal Influence samples	0.103	NV	0.103	Nonparametric UTL ⁽³⁾
Thallium	No Tidal Influence Surface soil (0-0.5 feet) samples	0.142	NV	0.142	Nonparametric UTL ⁽³⁾
Thallium	No Tidal Influence Shallow soil (1-2 feet) samples	0.197	NV	0.197	Normal UTL
Vanadium	Surface soil (0-0.5 feet) samples	34.9	50	50	Gamma UTL
Vanadium	Shallow soil (1-2 feet) samples	51.5	50	51.5	Normal UTL
Zinc	All samples	280	30	280	Gamma UTL
2,4,5-TP (Silvex)	All samples	0.0038	NV	0.0038	Nonparametric UTL ⁽³⁾
2,4-D	All samples	0.012	NV	0.012	Nonparametric UTL ⁽³⁾
2,4-DB	All samples	0.085	NV	0.085	Nonparametric UTL ⁽³⁾
4,4'-DDD	All samples	0.043	NV	0.043	Nonparametric UTL ⁽³⁾
4,4'-DDE	All samples	0.0093	NV	0.0093	Nonparametric UTL ⁽³⁾

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4,4'-DDT	All samples	0.03	NV	0.03	Nonparametric UTL ⁽³⁾
Aldrin	All samples	0.002	NV	0.002	Nonparametric UTL ⁽³⁾
alpha-BHC	All samples	0.0021	NV	0.0021	Nonparametric UTL ⁽³⁾
alpha-Chlordane	All samples	0.29	NV	0.29	Nonparametric UTL ⁽³⁾
beta-BHC	All samples	0.0026	NV	0.0026	Nonparametric UTL ⁽³⁾
Dalapon	Tidal Influence samples	0.24	NV	0.24	Nonparametric UTL ⁽³⁾
Dalapon	No Tidal Influence Surface soil (0-0.5 feet) samples	0.0055	NV	0.0055	Nonparametric UTL ⁽³⁾
Dalapon	No Tidal Influence Shallow soil (1-2 feet) samples	0.024	NV	0.024	Nonparametric UTL ⁽³⁾
delta-BHC	All samples	0.0014	NV	0.0014	Nonparametric UTL ⁽³⁾
Dicamba	All samples	0.0087	NV	0.0087	Nonparametric UTL ⁽³⁾
Dichlorprop	All samples	0.025	NV	0.025	Nonparametric UTL ⁽³⁾
Dieldrin	Tidal Influence samples	0.0031	NV	0.0031	Nonparametric UTL ⁽³⁾
Dieldrin	No Tidal Influence samples	0.052	NV	0.052	Nonparametric UTL ⁽³⁾
Dinoseb	Tidal Influence Surface soil (0-0.5 feet) samples	0.0092	NV	0.0092	Normal UTL
Dinoseb	Tidal Influence Shallow soil (1-2 feet) samples	0.0031	NV	0.0031	Nonparametric UTL ⁽³⁾
Dinoseb	No Tidal Influence Surface soil (0-0.5 feet) samples	0.025	NV	0.025	Nonparametric UTL ⁽³⁾
Dinoseb	No Tidal Influence Shallow soil (1-2 feet) samples	0.018	NV	0.018	Nonparametric UTL ⁽³⁾
Endosulfan I	All samples	0.0061	NV	0.0061	Nonparametric UTL ⁽³⁾
Endosulfan II	All samples	0.007	NV	0.007	Nonparametric UTL ⁽³⁾
Endosulfan sulfate	Surface soil (0-0.5 feet) samples	0.0049	NV	0.0049	Nonparametric UTL ⁽³⁾
Endrin	All samples	0.013	NV	0.013	Nonparametric UTL ⁽³⁾
Endrin aldehyde	Surface soil (0-0.5 feet) samples	0.0051	NV	0.0051	Nonparametric UTL ⁽³⁾
Endrin ketone	All samples	0.0037	NV	0.0037	Nonparametric UTL ⁽³⁾
gamma-BHC	All samples	0.0014	NV	0.0014	Nonparametric UTL ⁽³⁾
gamma-Chlordane	All samples	0.23	NV	0.23	Nonparametric UTL ⁽³⁾
Heptachlor	No Tidal Influence samples	0.013	NV	0.013	Nonparametric UTL ⁽³⁾
Heptachlor epoxide	No Tidal Influence samples	0.046	NV	0.046	Nonparametric UTL ⁽³⁾
MCPP	All samples	8	NV	8	Nonparametric UTL ⁽³⁾
1,1'-Biphenyl	All samples	0.016	NV	0.016	Nonparametric UTL ⁽³⁾
1-Methylnaphthalene	All samples	0.36	NV	0.36	Nonparametric UTL ⁽³⁾
2-Methylnaphthalene	All samples	0.4	NV	0.4	Nonparametric UTL ⁽³⁾
Acenaphthene	Surface soil (0-0.5 feet) samples	0.0464	NV	0.0464	Lognormal UTL
Acenaphthene	Shallow soil (1-2 feet) samples	0.0092	NV	0.0092	Nonparametric UTL ⁽³⁾
Acenaphthylene	Surface soil (0-0.5 feet) samples	0.018	NV	0.018	Nonparametric UTL ⁽³⁾
Acenaphthylene	Shallow soil (1-2 feet) samples	0.0064	NV	0.0064	Nonparametric UTL ⁽³⁾
Acetophenone	Surface soil (0-0.5 feet) samples	0.014	NV	0.014	Nonparametric UTL ⁽³⁾
Anthracene	Tidal Influence Surface soil (0-0.5 feet) samples	0.178	NV	0.178	Normal UTL
Anthracene	Tidal Influence Shallow soil (1-2 feet) samples	0.0392	NV	0.0392	Normal UTL
Anthracene	No Tidal Influence Surface soil (0-0.5 feet) samples	0.055	NV	0.055	Normal UTL
Anthracene	No Tidal Influence Shallow soil (1-2 feet) samples	0.078	NV	0.078	Nonparametric UTL ⁽³⁾

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Benz(a)anthracene	Tidal Influence Surface soil (0-0.5 feet) samples	1.38	NV	1.38	Normal UTL
Benz(a)anthracene	Tidal Influence Shallow soil (1-2 feet) samples	0.32	NV	0.32	Normal UTL
Benz(a)anthracene	No Tidal Influence Surface soil (0-0.5 feet) samples	1.22	NV	1.22	Gamma UTL
Benz(a)anthracene	No Tidal Influence Shallow soil (1-2 feet) samples	0.29	NV	0.29	Nonparametric UTL ⁽³⁾
Benzaldehyde	Surface soil (0-0.5 feet) samples	0.0073	NV	0.0073	Nonparametric UTL ⁽³⁾
Benzaldehyde	Shallow soil (1-2 feet) samples	0.0035	NV	0.0035	Nonparametric UTL ⁽³⁾
Benzo(a)pyrene	Tidal Influence Surface soil (0-0.5 feet) samples	1.75	NV	1.75	Normal UTL
Benzo(a)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	0.384	NV	0.384	Normal UTL
Benzo(a)pyrene	No Tidal Influence Surface soil (0-0.5 feet) samples	1.85	NV	1.85	Gamma UTL
Benzo(a)pyrene	No Tidal Influence Shallow soil (1-2 feet) samples	0.36	NV	0.36	Nonparametric UTL ⁽³⁾
Benzo(b)fluoranthene	Tidal Influence Surface soil (0-0.5 feet) samples	3.1	NV	3.1	Normal UTL
Benzo(b)fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	1	NV	1	Gamma UTL
Benzo(b)fluoranthene	No Tidal Influence Surface soil (0-0.5 feet) samples	2.56	NV	2.56	Gamma UTL
Benzo(b)fluoranthene	No Tidal Influence Shallow soil (1-2 feet) samples	0.51	NV	0.51	Nonparametric UTL ⁽³⁾
Benzo(g,h,i)perylene	Tidal Influence Surface soil (0-0.5 feet) samples	1.56	NV	1.56	Normal UTL
Benzo(g,h,i)perylene	Tidal Influence Shallow soil (1-2 feet) samples	0.293	NV	0.293	Normal UTL
Benzo(g,h,i)perylene	No Tidal Influence Surface soil (0-0.5 feet) samples	0.436	NV	0.436	Normal UTL
Benzo(g,h,i)perylene	No Tidal Influence Shallow soil (1-2 feet) samples	0.23	NV	0.23	Nonparametric UTL ⁽³⁾
Benzo(k)fluoranthene	Tidal Influence Surface soil (0-0.5 feet) samples	1.51	NV	1.51	Normal UTL
Benzo(k)fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	0.264	NV	0.264	Normal UTL
Benzo(k)fluoranthene	No Tidal Influence Surface soil (0-0.5 feet) samples	1.2	NV	1.2	Gamma UTL
Benzo(k)fluoranthene	No Tidal Influence Shallow soil (1-2 feet) samples	0.25	NV	0.25	Nonparametric UTL ⁽³⁾
Bis(2-ethylhexyl)phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	0.536	NV	0.536	Normal UTL
Bis(2-ethylhexyl)phthalate	Tidal Influence Shallow soil (1-2 feet) samples	0.166	NV	0.166	Normal UTL
Bis(2-ethylhexyl)phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	0.185	NV	0.185	Normal UTL
Bis(2-ethylhexyl)phthalate	No Tidal Influence Shallow soil (1-2 feet) samples	0.26	NV	0.26	Nonparametric UTL ⁽³⁾
Butyl benzyl phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	0.261	NV	0.261	Normal UTL
Butyl benzyl phthalate	Tidal Influence Shallow soil (1-2 feet) samples	0.072	NV	0.072	Nonparametric UTL ⁽³⁾
Butyl benzyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	0.291	NV	0.291	Lognormal UTL
Butyl benzyl phthalate	No Tidal Influence Shallow soil (1-2 feet) samples	0.061	NV	0.061	Nonparametric UTL ⁽³⁾
Caprolactam	All samples	0.0066	NV	0.0066	Nonparametric UTL ⁽³⁾
Carbazole	Tidal Influence Surface soil (0-0.5 feet) samples	0.172	NV	0.172	Normal UTL
Carbazole	Tidal Influence Shallow soil (1-2 feet) samples	0.0403	NV	0.0403	Normal UTL
Carbazole	No Tidal Influence Surface soil (0-0.5 feet) samples	0.0586	NV	0.0586	Normal UTL
Carbazole	No Tidal Influence Shallow soil (1-2 feet) samples	0.032	NV	0.032	Nonparametric UTL ⁽³⁾
Chrysene	Tidal Influence Surface soil (0-0.5 feet) samples	2.3	NV	2.3	Normal UTL
Chrysene	Tidal Influence Shallow soil (1-2 feet) samples	0.479	NV	0.479	Normal UTL
Chrysene	No Tidal Influence Surface soil (0-0.5 feet) samples	1.9	NV	1.9	Gamma UTL
Chrysene	No Tidal Influence Shallow soil (1-2 feet) samples	0.43	NV	0.43	Nonparametric UTL ⁽³⁾
Dibenz(a,h)anthracene	Surface soil (0-0.5 feet) samples	0.294	NV	0.294	Normal UTL

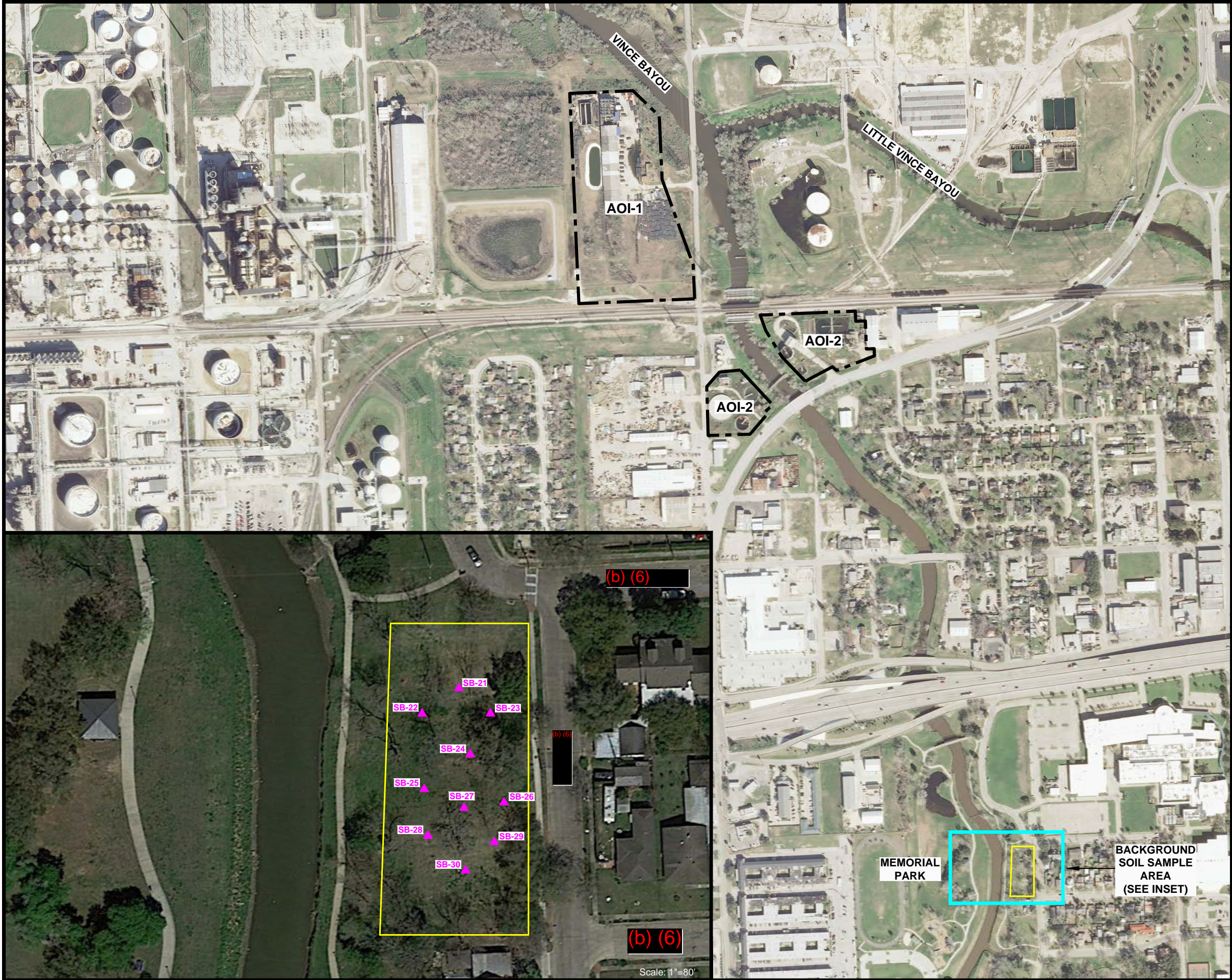
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Dibenz(a,h)anthracene	Shallow soil (1-2 feet) samples	0.12	NV	0.12	Nonparametric UTL ⁽³⁾
Dibenzofuran	Tidal Influence Surface soil (0-0.5 feet) samples	0.016	NV	0.016	Nonparametric UTL ⁽³⁾
Dibenzofuran	Tidal Influence Shallow soil (1-2 feet) samples	0.0025	NV	0.0025	Nonparametric UTL ⁽³⁾
Dibenzofuran	No Tidal Influence samples	0.014	NV	0.014	Nonparametric UTL ⁽³⁾
Diethyl phthalate	All samples	0.0069	NV	0.0069	Nonparametric UTL ⁽³⁾
Dimethyl phthalate	All samples	0.0025	NV	0.0025	Nonparametric UTL ⁽³⁾
Di-n-butyl phthalate	Tidal Influence samples	0.0234	NV	0.0234	Normal UTL
Di-n-butyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	0.0236	NV	0.0236	Lognormal UTL
Di-n-butyl phthalate	No Tidal Influence Shallow soil (1-2 feet) samples	0.0053	NV	0.0053	Nonparametric UTL ⁽³⁾
Di-n-octyl phthalate	Surface soil (0-0.5 feet) samples	0.055	NV	0.055	Nonparametric UTL ⁽³⁾
Di-n-octyl phthalate	Shallow soil (1-2 feet) samples	0.022	NV	0.022	Nonparametric UTL ⁽³⁾
Fluoranthene	Tidal Influence Surface soil (0-0.5 feet) samples	3.68	NV	3.68	Normal UTL
Fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	1.07	NV	1.07	Gamma UTL
Fluoranthene	No Tidal Influence Surface soil (0-0.5 feet) samples	3.19	NV	3.19	Gamma UTL
Fluoranthene	No Tidal Influence Shallow soil (1-2 feet) samples	0.63	NV	0.63	Nonparametric UTL ⁽³⁾
Fluorene	Tidal Influence Surface soil (0-0.5 feet) samples	0.0476	NV	0.0476	Normal UTL
Fluorene	Tidal Influence Shallow soil (1-2 feet) samples	0.0064	NV	0.0064	Nonparametric UTL ⁽³⁾
Fluorene	No Tidal Influence Surface soil (0-0.5 feet) samples	0.012	NV	0.012	Nonparametric UTL ⁽³⁾
Fluorene	No Tidal Influence Shallow soil (1-2 feet) samples	0.013	NV	0.013	Nonparametric UTL ⁽³⁾
Hexachlorobutadiene	All samples	0.0091	NV	0.0091	Nonparametric UTL ⁽³⁾
Indeno(1,2,3-cd)pyrene	Tidal Influence Surface soil (0-0.5 feet) samples	1.88	NV	1.88	Normal UTL
Indeno(1,2,3-cd)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	0.417	NV	0.417	Normal UTL
Indeno(1,2,3-cd)pyrene	No Tidal Influence Surface soil (0-0.5 feet) samples	1.69	NV	1.69	Gamma UTL
Indeno(1,2,3-cd)pyrene	No Tidal Influence Shallow soil (1-2 feet) samples	0.28	NV	0.28	Nonparametric UTL ⁽³⁾
Naphthalene	All samples	0.11	NV	0.11	Nonparametric UTL ⁽³⁾
Phenanthrene	Tidal Influence Surface soil (0-0.5 feet) samples	1.03	NV	1.03	Normal UTL
Phenanthrene	Tidal Influence Shallow soil (1-2 feet) samples	0.294	NV	0.294	Gamma UTL
Phenanthrene	No Tidal Influence Surface soil (0-0.5 feet) samples	0.365	NV	0.365	Normal UTL
Phenanthrene	No Tidal Influence Shallow soil (1-2 feet) samples	0.3	NV	0.3	Nonparametric UTL ⁽³⁾
Phenol	All samples	0.002	NV	0.002	Nonparametric UTL ⁽³⁾
Pyrene	Tidal Influence Surface soil (0-0.5 feet) samples	2.84	NV	2.84	Normal UTL
Pyrene	Tidal Influence Shallow soil (1-2 feet) samples	0.792	NV	0.792	Gamma UTL
Pyrene	No Tidal Influence Surface soil (0-0.5 feet) samples	2.54	NV	2.54	Gamma UTL
Pyrene	No Tidal Influence Shallow soil (1-2 feet) samples	0.58	NV	0.58	Nonparametric UTL ⁽³⁾

Notes:

1. Texas-Specific Soil Background Concentrations per 30 TAC 350.51(m)
 2. The representative background concentration is the higher of the Site-Specific Background Concentration and the Texas -Specific Background concentration
 3. Nonparametric UTL computed because 60% or less of the background soil concentrations were detected.
- NV = No value for constituent in 30 TAC 350.51(m)

FIGURES



EXPLANATION

- Approx. Property Boundary
- Background Soil Sampling Area
- ▲ Non-Tidally Influenced Background Sample Location



Approx. Scale in Feet
0 250 500

Source:
Houston-Galveston Area Council, April 2012 Image, 2012 Aerial Imagery Data is the sole property of Houston-Galveston Area Council, which reserves all rights thereto. Use or reproduction of this data is strictly prohibited absent written consent from the Houston-Galveston Area Council.

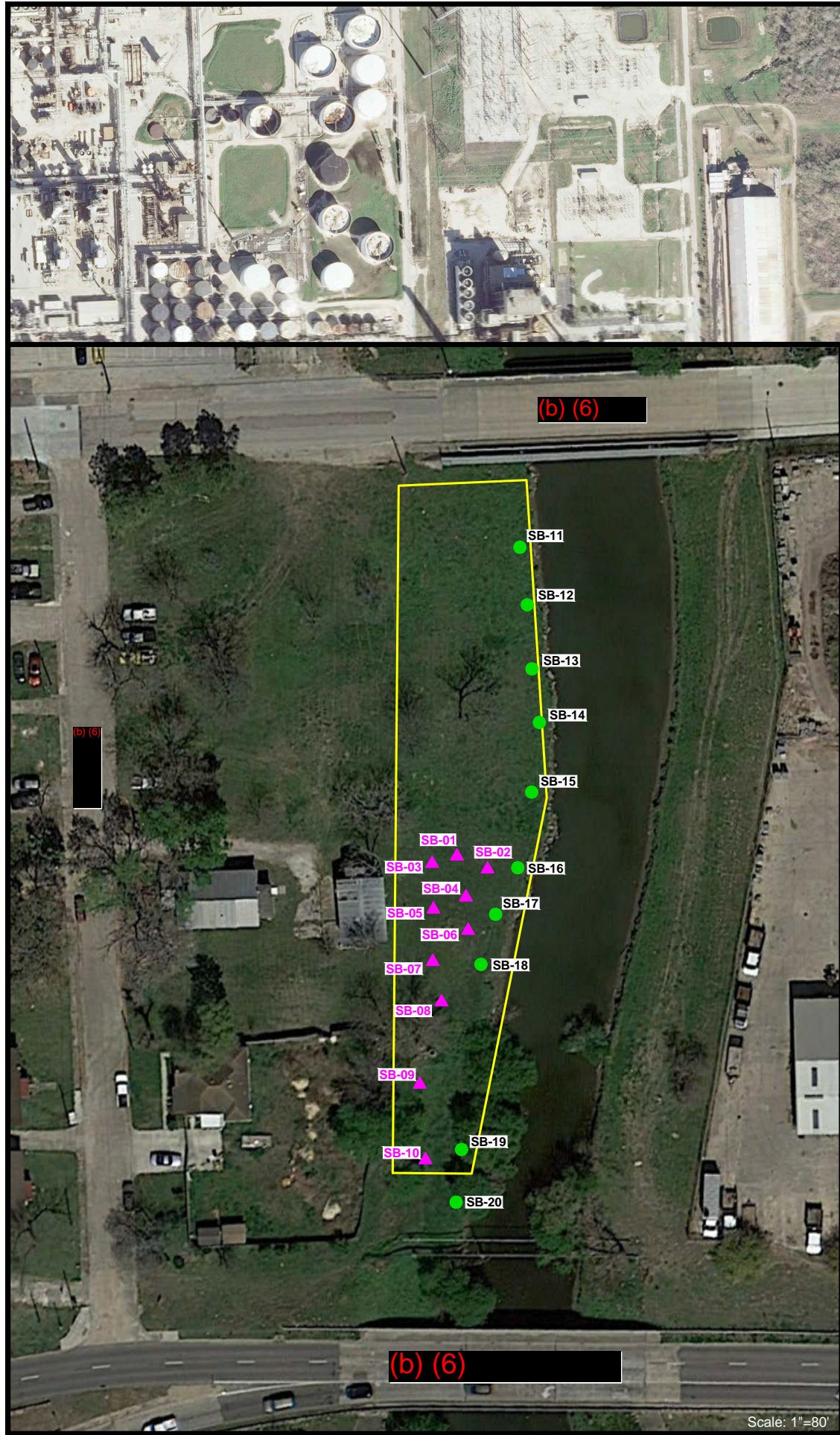
**US OIL RECOVERY SUPERFUND SITE
PASADENA, HARRIS COUNTY, TEXAS**

Figure 1

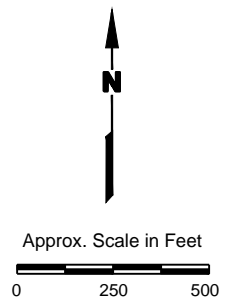
**BACKGROUND
SOIL SAMPLE LOCATIONS
(b) (6) BACKGROUND LOCATION**

PROJECT: 3333	BY: AJD	REVISIONS
DATE: MAY, 2017	CHECKED: MKW	

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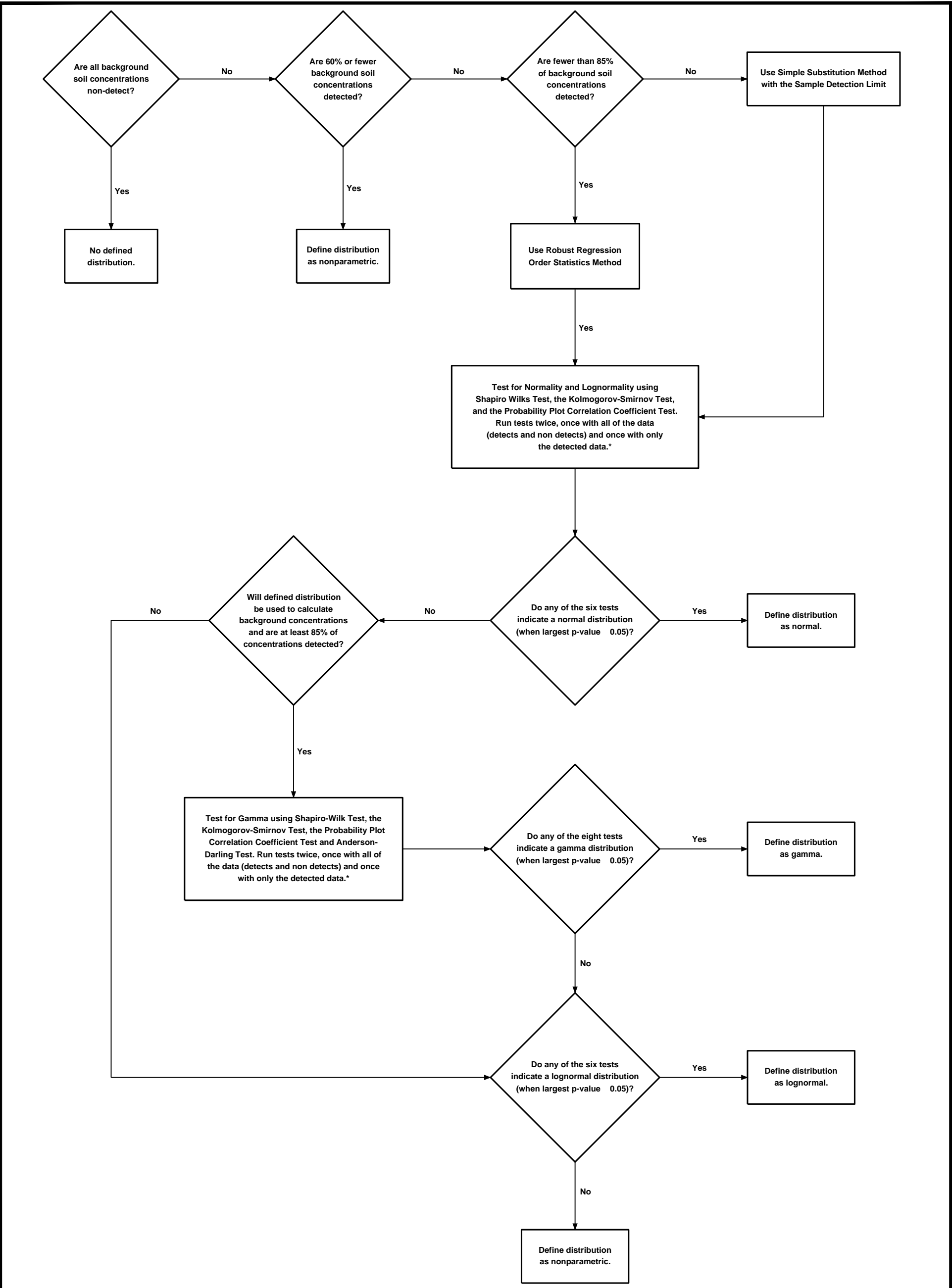


- EXPLANATION**
- Approx. Property Boundary
 - Background Soil Sampling Area
 - ▲ Non-Tidally Influenced Background Sample Location
 - Tidally Influenced Background Sample Location



Source:
Houston-Galveston Area Council, April 2012 Image, 2012 Aerial Imagery Data is the sole property of Houston-Galveston Area Council, which reserves all rights thereto. Use or reproduction of this data is strictly prohibited absent written consent from the Houston-Galveston Area Council.

US OIL RECOVERY SUPERFUND SITE PASADENA, HARRIS COUNTY, TEXAS		
Figure 2		
BACKGROUND SOIL SAMPLE LOCATIONS (b) (6) BACKGROUND LOCATION		
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Note:
* - For a data group with more than 60% and less than 85% detected concentrations, the Kolmogorov-Smirnov Test could not be performed using all of the data. Also, the Shapiro-Wilks Test could not be performed using all the data when multiple censoring concentrations for non-detects were present.

US OIL RECOVERY SUPERFUND SITE
PASADENA, HARRIS COUNTY, TEXAS

Figure 4
**PROCESS FOR
DEFINING A DISTRIBUTION
FOR A DATA GROUP**

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Attachment A – Data Groupings

Background soil concentration data for each constituent were evaluated to define which constituent data sets could be combined to form larger data sets for the purposes of calculating representative background concentrations. The data sets include data from background soil samples collected from tidally and non-tidally influenced areas and from the 0-0.5 and 1-2 feet bgs soil depth intervals, in accordance with WRN-AOI-1-3. To define data groupings, population means for each data set were compared using two-sample, two-sided statistical hypothesis tests for each constituent (Figure 3). The first means comparison tested whether tidally and non-tidally influenced samples were statistically different, with the results evaluated as follows:

1. If no statistical significance exists between the tidally and non-tidally influenced samples for a constituent, then a means comparison test was performed to define whether a statistical significance exists between the surface soil (0-0.5 feet) and shallow soil (1-2 feet bgs) samples.
2. If a statistically significant difference exists between the tidally and non-tidally influenced samples for a constituent, then two means comparison tests were performed to define whether statistical significance(s) existed between:
 - a. The tidally influenced, surface soil (0-0.5 feet) and the tidally influenced, shallow soil (1-2 feet bgs) samples; and
 - b. The non-tidally influenced, surface soil (0-0.5 feet) and the non-tidally influenced, shallow soil (1-2 feet bgs) samples.

Statistical significance was based on a 95% level of confidence for each hypothesis test. Results from these tests were used to identify background data grouping(s) for each constituent. Based on the results of these comparisons, an appropriate data group was defined for each constituent for use in the calculation of representative background concentrations. As few as one and as many as four groupings could be selected for a constituent from the following list:

- all samples (60 samples);
- surface soil (30 samples);
- shallow soil (30 samples);
- tidally influenced, surface soil (10 samples);
- tidally influenced, shallow soil (10 samples);
- non-tidally influenced surface soil (20 samples);
- non-tidally influenced shallow soil (20 samples).

Tables A-1 through A-4 present the results of these tests and define how each constituent's data set was grouped.

The type of hypothesis test performed was dependent on the defined distribution for each data set. Figure 4 outlines the steps taken to define whether a data set follows a normal, lognormal, or nonparametric distribution. If there were no detections for a specific constituent, no distribution was defined for that constituent. For a data group with 60% or fewer detected concentrations, the distribution was defined as nonparametric. Typically, nonparametric approaches are used when there are fewer than 50% detected concentrations (EPA, 2009). For this background study, however, a more conservative approach was taken, with 60% being used as the threshold. Using this approach, statistical tests were not artificially influenced by the type of adjustments made for non-detect concentrations.

For data groups with more than 60% of detected concentrations, three distributional tests were performed: 1) Shapiro-Wilks test, 2) Kolmogorov-Smirnov test, and 3) PPCC test. These distributional tests are recommended by EPA (EPA, 2000; EPA, 2002; EPA, 2009; EPA, 2017). Each distributional test was run twice, as follows:

- Once with the all of the data (detects and not detects), including adjustments made for non-detect concentrations, as described in the Data Preparation section above; and
- Once with only the detected data.

Running distributional tests with only detected data follows the procedures in EPA, 2017. Furthermore, the method used to draw distributional conclusions, which uses the largest p-value from all of the appropriate tests and compares it to a 95% level of significance, was designed to follow ProUCL's distributional recommendations. It should be noted that for data sets with more than 60% and less than 85% detected sample concentrations, the Kolmogorov-Smirnov test could not be performed using all of the data and the Shapiro-Wilks could not be performed using all the data when multiple censoring concentrations for non-detects were present.

If results from any of the six tests (using the Shapiro-Wilks, Kolmogorov-Smirnov, and PPCC tests for all the data and for only the detected data) indicated that the data are normally distributed (when the largest p-value is greater than 0.05), the distribution was defined as normal. If none of the six test results indicate normality, the data's distribution was defined as

nonparametric.

Using results from the distributional tests for each data group, the appropriate two-sample, two-sided hypothesis test was performed, using a 95% level of significance. When two data sets being compared could both be defined as having normal distributions, a normal t-test was performed. When one of the two data sets being compared was defined as nonparametric, the Tarone-Ware or Wilcoxon Rank-Sum test (EPA, 2009 and EPA, 2017), a nonparametric test, was used. The Tarone-Ware test was used when one or two of the data sets being compared had at least one non-detect. The Wilcoxon Rank-Sum test was used when both data sets being compared had all detected concentrations.

The type of t-test used depended on whether the two data sets have equal or unequal variances. If the less frequently detected data set had more than 60% detected concentrations but less than 85% detected concentrations, the t-test was performed assuming equal variances. Equal variances were assumed rather than formally verified due to the considerable number of non-detects, consistent with EPA, 2009. If the less frequently detected data set had at least 85% detected concentrations, both the Levene's test and Bartlett's test were performed to test for equal variances. If either test indicated that there was not a statistical difference between the variances (with a 95% level of significance), the t-test was performed assuming equal variances; otherwise, the t-test was adjusted for unequal variances.

When any hypothesis test indicated that there was not a statistical difference between two data sets (when the p-value is greater than 0.05), the two data sets were combined. For example, if a constituent's tidally-influenced sample concentrations were not statistically different from the non-tidally influenced sample concentrations, that constituent's data group included both the tidally-influenced and non-tidally influenced sample concentrations. An additional means comparison was performed to determine whether that constituent's surface soil and shallow soil sample concentrations were statistically different.

The open source, statistical software **R** (The R Foundation, 2017) was used to perform these hypothesis tests, distributional tests, and tests of equal variances.

ATTACHMENT A TABLES

Attachment A
Table A-1
Means Comparisons Results for Data Groupings: Comparing Tidally- and Non-Tidally Influenced Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Aluminum	All Surface Soil Samples; All Shallow Soil Samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.15
Antimony	All samples	11	28	9	45	Tarone-Ware	NS	0.46
Arsenic	All Surface Soil Samples; All Shallow Soil Samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.15
Barium	All Surface Soil Samples; All Shallow Soil Samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.20
Beryllium	All Surface Soil Samples; All Shallow Soil Samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.09
Boron	All Surface Soil Samples; All Shallow Soil Samples	39	98	20	100	Normal t-test (equal variances)	NS	0.63
Cadmium	All samples	31	78	20	100	Tarone-Ware	NS	0.07
Chromium	All Surface Soil Samples; All Shallow Soil Samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.77
Cobalt	All Surface Soil Samples; All Shallow Soil Samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.11

Attachment A
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US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Copper	All No Tidal Influenced Samples; All Tidal Influenced Samples	40	100	20	100	Wilcoxon Rank-Sum	S	0.02
Lead	All samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.09
Manganese	All Surface Soil Samples; All Shallow Soil Samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.31
Nickel	All Surface Soil Samples; All Shallow Soil Samples	40	100	20	100	Normal t-test (unequal variances)	NS	0.40
Selenium	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	40	100	20	100	Normal t-test (unequal variances)	S	0.01
Silver	All No Tidal Influenced Samples; All Tidal Influenced Samples	10	25	13	65	Tarone-Ware	S	<0.005
Thallium	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	23	58	7	35	Tarone-Ware	S	0.03
Vanadium	All Surface Soil Samples; All Shallow Soil Samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.13

Attachment A
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US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Zinc	All samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.12
Mercury	All samples	40	100	20	100	Wilcoxon Rank-Sum	NS	0.08
4,4'-DDD	All samples	15	38	5	25	Tarone-Ware	NS	0.31
4,4'-DDE	All samples	10	25	5	25	Tarone-Ware	NS	0.96
4,4'-DDT	All samples	16	40	8	40	Tarone-Ware	NS	0.59
Aldrin	All samples	2	5	0	0	Tarone-Ware	NS	0.31
Dieldrin	All No Tidal Influenced Samples; All Tidal Influenced Samples	14	35	1	5	Tarone-Ware	S	0.02
Endosulfan I	All samples	3	8	0	0	Tarone-Ware	NS	0.21
Endosulfan II	All samples	2	5	0	0	Tarone-Ware	NS	0.31
Endosulfan sulfate	All Surface Soil Samples; All Shallow Soil Samples	3	8	3	15	Tarone-Ware	NS	0.35
Endrin	All samples	4	10	2	10	Tarone-Ware	NS	0.92
Endrin aldehyde	All Surface Soil Samples; All Shallow Soil Samples	3	8	1	5	Tarone-Ware	NS	0.73
Endrin ketone	All samples	2	5	3	15	Tarone-Ware	NS	0.17
Heptachlor	All No Tidal Influenced Samples; All Tidal Influenced Samples	8	20	0	0	Tarone-Ware	S	0.04
Heptachlor epoxide	All No Tidal Influenced Samples; All Tidal Influenced Samples	11	28	0	0	Tarone-Ware	S	0.01
Methoxychlor	All samples (all NDs)	0	0	0	0	--	ND	--
Toxaphene	All samples (all NDs)	0	0	0	0	--	ND	--

Attachment A
Table A-1
Means Comparisons Results for Data Groupings: Comparing Tidally- and Non-Tidally Influenced Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
alpha-BHC	All samples	1	3	0	0	Tarone-Ware	NS	0.48
alpha-Chlordane	All samples	16	40	6	30	Tarone-Ware	NS	0.29
beta-BHC	All samples	2	5	1	5	Tarone-Ware	NS	0.98
delta-BHC	All samples	4	10	1	5	Tarone-Ware	NS	0.54
gamma-BHC	All samples	0	0	1	5	Tarone-Ware	NS	0.16
gamma-Chlordane	All samples	18	45	9	45	Tarone-Ware	NS	0.72
2,4,5-T	All samples (all NDs)	0	0	0	0	--	ND	--
2,4,5-TP (Silvex)	All samples	3	8	0	0	Tarone-Ware	NS	0.21
2,4-D	All samples	2	5	2	10	Tarone-Ware	NS	0.48
2,4-DB	All samples	9	23	8	40	Tarone-Ware	NS	0.40
Dalapon	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	9	23	10	50	Tarone-Ware	S	0.01
Dicamba	All samples	1	3	1	5	Tarone-Ware	NS	0.60
Dichlorprop	All samples	4	10	3	15	Tarone-Ware	NS	0.62
Dinoseb	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	7	18	10	50	Tarone-Ware	S	0.01
MCPA	All samples (all NDs)	0	0	0	0	--	ND	--

Attachment A
Table A-1
Means Comparisons Results for Data Groupings: Comparing Tidally- and Non-Tidally Influenced Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
MCP	All samples	9	23	6	30	Tarone-Ware	NS	0.62
1,1'-Biphenyl	All samples	4	10	3	15	Tarone-Ware	NS	0.78
1,2,4,5-Tetrachlorobenzene	All samples (all NDs)	0	0	0	0	--	ND	--
1,4-Dioxane	All samples (all NDs)	0	0	0	0	--	ND	--
1-Methylnaphthalene	All samples	12	30	7	35	Tarone-Ware	NS	0.54
2,3,4,6-Tetrachlorophenol	All samples (all NDs)	0	0	0	0	--	ND	--
2,4,5-Trichlorophenol	All samples (all NDs)	0	0	0	0	--	ND	--
2,4,6-Trichlorophenol	All samples (all NDs)	0	0	0	0	--	ND	--
2,4-Dichlorophenol	All samples (all NDs)	0	0	0	0	--	ND	--
2,4-Dimethylphenol	All samples (all NDs)	0	0	0	0	--	ND	--
2,4-Dinitrophenol	All samples (all NDs)	0	0	0	0	--	ND	--
2,4-Dinitrotoluene	All samples (all NDs)	0	0	0	0	--	ND	--
2,6-Dinitrotoluene	All samples (all NDs)	0	0	0	0	--	ND	--
2-Chloronaphthalene	All samples (all NDs)	0	0	0	0	--	ND	--
2-Chlorophenol	All samples (all NDs)	0	0	0	0	--	ND	--
2-Methylnaphthalene	All samples	14	35	8	40	Tarone-Ware	NS	0.75
2-Methylphenol	All samples (all NDs)	0	0	0	0	--	ND	--
2-Nitroaniline	All samples (all NDs)	0	0	0	0	--	ND	--
2-Nitrophenol	All samples (all NDs)	0	0	0	0	--	ND	--
3,3'-Dichlorobenzidine	All samples (all NDs)	0	0	0	0	--	ND	--
3-Methylphenol	All samples (all NDs)	0	0	0	0	--	ND	--
3-Nitroaniline	All samples (all NDs)	0	0	0	0	--	ND	--
4,6-Dinitro-2-methylphenol	All samples (all NDs)	0	0	0	0	--	ND	--
4-Bromophenyl phenyl ether	All samples (all NDs)	0	0	0	0	--	ND	--

Attachment A
Table A-1
Means Comparisons Results for Data Groupings: Comparing Tidally- and Non-Tidally Influenced Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
4-Chloro-3-methylphenol	All samples (all NDs)	0	0	0	0	--	ND	--
4-Chlorophenyl phenyl ether	All samples (all NDs)	0	0	0	0	--	ND	--
4-Methylphenol	All samples (all NDs)	0	0	0	0	--	ND	--
4-Nitroaniline	All samples (all NDs)	0	0	0	0	--	ND	--
4-Nitrophenol	All samples (all NDs)	0	0	0	0	--	ND	--
Acenaphthene	All Surface Soil Samples; All Shallow Soil Samples	13	33	11	55	Tarone-Ware	NS	0.06
Acenaphthylene	All Surface Soil Samples; All Shallow Soil Samples	14	35	10	50	Tarone-Ware	NS	0.07
Acetophenone	All Surface Soil Samples; All Shallow Soil Samples	8	20	2	10	Tarone-Ware	NS	0.39

Attachment A
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Means Comparisons Results for Data Groupings: Comparing Tidally- and Non-Tidally Influenced Samples
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US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Anthracene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	19	48	18	90	Tarone-Ware	S	<0.005
Atrazine	All samples (all NDs)	0	0	0	0	--	ND	--
Benz(a)anthracene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	29	73	20	100	Tarone-Ware	S	<0.005
Benzaldehyde	All Surface Soil Samples; All Shallow Soil Samples	11	28	1	5	Tarone-Ware	NS	0.09
Benzo(a)pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	28	70	20	100	Tarone-Ware	S	<0.005

Attachment A
Table A-1
Means Comparisons Results for Data Groupings: Comparing Tidally- and Non-Tidally Influenced Samples
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US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Benzo(b)fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	28	70	20	100	Tarone-Ware	S	<0.005
Benzo(g,h,i)perylene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	25	63	20	100	Tarone-Ware	S	<0.005
Benzo(k)fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	29	73	20	100	Tarone-Ware	S	<0.005
Bis(2-chloroethoxy)methane	All samples (all NDs)	0	0	0	0	--	ND	--
Bis(2-chloroethyl)ether	All samples (all NDs)	0	0	0	0	--	ND	--
Bis(2-chloroisopropyl)ether	All samples (all NDs)	0	0	0	0	--	ND	--

Attachment A
Table A-1
Means Comparisons Results for Data Groupings: Comparing Tidally- and Non-Tidally Influenced Samples
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US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Bis(2-ethylhexyl)phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	32	80	20	100	Tarone-Ware	S	<0.005
Butyl benzyl phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	19	48	15	75	Tarone-Ware	S	<0.005
Caprolactam	All samples	2	5	0	0	Tarone-Ware	NS	0.36
Carbazole	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	17	43	18	90	Tarone-Ware	S	<0.005

Attachment A
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Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Chrysene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	31	78	20	100	Tarone-Ware	S	<0.005
Di-n-butyl phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	17	43	14	70	Tarone-Ware	S	<0.005
Di-n-octyl phthalate	All Surface Soil Samples; All Shallow Soil Samples	5	13	5	25	Tarone-Ware	NS	0.10
Dibenz(a,h)anthracene	All Surface Soil Samples; All Shallow Soil Samples	21	53	12	60	Tarone-Ware	NS	0.11
Dibenzofuran	All No Tidal Influenced Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	25	10	50	Tarone-Ware	S	0.03
Diethyl phthalate	All samples	1	3	0	0	Tarone-Ware	NS	0.47
Dimethyl phthalate	All samples	1	3	0	0	Tarone-Ware	NS	0.54

Attachment A
Table A-1
Means Comparisons Results for Data Groupings: Comparing Tidally- and Non-Tidally Influenced Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	31	78	20	100	Tarone-Ware	S	<0.005
Fluorene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	14	35	12	60	Tarone-Ware	S	0.02
Hexachlorobenzene	All samples (all NDs)	0	0	0	0	--	ND	--
Hexachlorobutadiene	All samples	0	0	1	5	Tarone-Ware	NS	0.16
Hexachlorocyclopentadiene	All samples (all NDs)	0	0	0	0	--	ND	--
Hexachloroethane	All samples (all NDs)	0	0	0	0	--	ND	--
Indeno(1,2,3-cd)pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	27	68	19	95	Tarone-Ware	S	<0.005
Isophorone	All samples (all NDs)	0	0	0	0	--	ND	--
N-Nitrosodi-n-propylamine	All samples (all NDs)	0	0	0	0	--	ND	--
N-Nitrosodiphenylamine	All samples (all NDs)	0	0	0	0	--	ND	--

Attachment A
Table A-1
Means Comparisons Results for Data Groupings: Comparing Tidally- and Non-Tidally Influenced Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Comparing Tidally- vs. No Tidally-Influenced						
		Non Tidally-Influence		Tidally-Influence		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Naphthalene	All samples	11	28	8	40	Tarone-Ware	NS	0.34
Nitrobenzene	All samples (all NDs)	0	0	0	0	--	ND	--
Pentachlorophenol	All samples (all NDs)	0	0	0	0	--	ND	--
Phenanthrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	23	58	20	100	Tarone-Ware	S	<0.005
Phenol	All samples	1	3	0	0	Tarone-Ware	NS	0.54
Pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	32	80	20	100	Tarone-Ware	S	<0.005

Notes:

ND = Means Comparison not applicable because the constituent was not detected in any sample for that data group.

-- = No Statistical Test performed due to one of the following factors:

- a.) the constituent was not detected in any sample for that data group;
- b.) a statistically significant difference was detected between Tidally- and Non Tidally-Influenced Samples, so no comparison performed across all samples; or
- c.) no statistical difference was detected between Tidally- and Non Tidally-Influenced Samples, so no comparisons were performed separately for Tidally- and Non Tidally-Influenced Samples.

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Aluminum	All Surface Soil Samples; All Shallow Soil Samples	30	100	30	100	Wilcoxon Rank-Sum	S	<0.005
Antimony	All samples	10	33	10	33	Tarone-Ware	NS	0.50
Arsenic	All Surface Soil Samples; All Shallow Soil Samples	30	100	30	100	Wilcoxon Rank-Sum	S	<0.005
Barium	All Surface Soil Samples; All Shallow Soil Samples	30	100	30	100	Wilcoxon Rank-Sum	S	<0.005
Beryllium	All Surface Soil Samples; All Shallow Soil Samples	30	100	30	100	Wilcoxon Rank-Sum	S	<0.005
Boron	All Surface Soil Samples; All Shallow Soil Samples	29	97	30	100	Normal t-test (equal variances)	S	0.02
Cadmium	All samples	27	90	24	80	Tarone-Ware	NS	0.72
Chromium	All Surface Soil Samples; All Shallow Soil Samples	30	100	30	100	Normal t-test (equal variances)	S	<0.005
Cobalt	All Surface Soil Samples; All Shallow Soil Samples	30	100	30	100	Wilcoxon Rank-Sum	S	<0.005
Copper	All No Tidal Influenced Samples; All Tidal Influenced Samples	--	--	--	--	--	--	--

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Lead	All samples	30	100	30	100	Wilcoxon Rank-Sum	NS	0.35
Manganese	All Surface Soil Samples; All Shallow Soil Samples	30	100	30	100	Wilcoxon Rank-Sum	S	0.01
Nickel	All Surface Soil Samples; All Shallow Soil Samples	30	100	30	100	Normal t-test (equal variances)	S	<0.005
Selenium	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Silver	All No Tidal Influenced Samples; All Tidal Influenced Samples	--	--	--	--	--	--	--
Thallium	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	--	--	--	--	--	--	--
Vanadium	All Surface Soil Samples; All Shallow Soil Samples	30	100	30	100	Wilcoxon Rank-Sum	S	<0.005
Zinc	All samples	30	100	30	100	Wilcoxon Rank-Sum	NS	0.12

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Mercury	All samples	30	100	30	100	Wilcoxon Rank-Sum	NS	0.60
4,4'-DDD	All samples	12	40	8	27	Tarone-Ware	NS	0.35
4,4'-DDE	All samples	9	30	6	20	Tarone-Ware	NS	0.24
4,4'-DDT	All samples	13	43	11	37	Tarone-Ware	NS	0.56
Aldrin	All samples	1	3	1	3	Tarone-Ware	NS	0.99
Dieldrin	All No Tidal Influenced Samples; All Tidal Influenced Samples	--	--	--	--	--	--	--
Endosulfan I	All samples	2	7	1	3	Tarone-Ware	NS	0.58
Endosulfan II	All samples	1	3	1	3	Tarone-Ware	NS	0.99
Endosulfan sulfate	All Surface Soil Samples; All Shallow Soil Samples	6	20	0	0	Tarone-Ware	S	0.01
Endrin	All samples	3	10	3	10	Tarone-Ware	NS	0.92
Endrin aldehyde	All Surface Soil Samples; All Shallow Soil Samples	4	13	0	0	Tarone-Ware	S	0.04
Endrin ketone	All samples	4	13	1	3	Tarone-Ware	NS	0.18
Heptachlor	All No Tidal Influenced Samples; All Tidal Influenced Samples	--	--	--	--	--	--	--
Heptachlor epoxide	All No Tidal Influenced Samples; All Tidal Influenced Samples	--	--	--	--	--	--	--
Methoxychlor	All samples (all NDs)	--	--	--	--	--	--	--
Toxaphene	All samples (all NDs)	--	--	--	--	--	--	--
alpha-BHC	All samples	1	3	0	0	Tarone-Ware	NS	0.32
alpha-Chlordane	All samples	10	33	12	40	Tarone-Ware	NS	0.75

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
beta-BHC	All samples	2	7	1	3	Tarone-Ware	NS	0.54
delta-BHC	All samples	3	10	2	7	Tarone-Ware	NS	0.64
gamma-BHC	All samples	1	3	0	0	Tarone-Ware	NS	0.32
gamma-Chlordane	All samples	15	50	12	40	Tarone-Ware	NS	0.53
2,4,5-T	All samples (all NDs)	--	--	--	--	--	--	--
2,4,5-TP (Silvex)	All samples	1	3	2	7	Tarone-Ware	NS	0.54
2,4-D	All samples	2	7	2	7	Tarone-Ware	NS	0.96
2,4-DB	All samples	10	33	7	23	Tarone-Ware	NS	0.43
Dalapon	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	--	--	--	--	--	--	--
Dicamba	All samples	1	3	1	3	Tarone-Ware	NS	0.99
Dichlorprop	All samples	4	13	3	10	Tarone-Ware	NS	0.69
Dinoseb	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
MCPA	All samples (all NDs)	--	--	--	--	--	--	--
MCPP	All samples	6	20	9	30	Tarone-Ware	NS	0.35
1,1'-Biphenyl	All samples	4	13	3	10	Tarone-Ware	NS	0.66
1,2,4,5-Tetrachlorobenzene	All samples (all NDs)	--	--	--	--	--	--	--

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
1,4-Dioxane	All samples (all NDs)	--	--	--	--	--	--	--
1-Methylnaphthalene	All samples	12	40	7	23	Tarone-Ware	NS	0.15
2,3,4,6-Tetrachlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dichlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dimethylphenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dinitrophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dinitrotoluene	All samples (all NDs)	--	--	--	--	--	--	--
2,6-Dinitrotoluene	All samples (all NDs)	--	--	--	--	--	--	--
2-Chloronaphthalene	All samples (all NDs)	--	--	--	--	--	--	--
2-Chlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2-Methylnaphthalene	All samples	14	47	8	27	Tarone-Ware	NS	0.16
2-Methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
2-Nitroaniline	All samples (all NDs)	--	--	--	--	--	--	--
2-Nitrophenol	All samples (all NDs)	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	All samples (all NDs)	--	--	--	--	--	--	--
3-Methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
3-Nitroaniline	All samples (all NDs)	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	All samples (all NDs)	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
4-Chlorophenyl phenyl ether	All samples (all NDs)	--	--	--	--	--	--	--
4-Methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
4-Nitroaniline	All samples (all NDs)	--	--	--	--	--	--	--

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
4-Nitrophenol	All samples (all NDs)	--	--	--	--	--	--	--
Acenaphthene	All Surface Soil Samples; All Shallow Soil Samples	19	63	5	17	Tarone-Ware	S	<0.005
Acenaphthylene	All Surface Soil Samples; All Shallow Soil Samples	16	53	8	27	Tarone-Ware	S	0.01
Acetophenone	All Surface Soil Samples; All Shallow Soil Samples	10	33	0	0	Tarone-Ware	S	<0.005
Anthracene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Atrazine	All samples (all NDs)	--	--	--	--	--	--	--

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Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Benz(a)anthracene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Benzaldehyde	All Surface Soil Samples; All Shallow Soil Samples	10	33	2	7	Tarone-Ware	S	<0.005
Benzo(a)pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Benzo(b)fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--

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Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Benzo(g,h,i)perylene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Benzo(k)fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Bis(2-chloroethoxy)methane	All samples (all NDs)	--	--	--	--	--	--	--
Bis(2-chloroethyl)ether	All samples (all NDs)	--	--	--	--	--	--	--
Bis(2-chloroisopropyl)ether	All samples (all NDs)	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Butyl benzyl phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Caprolactam	All samples	0	0	2	7	Tarone-Ware	NS	0.17
Carbazole	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Chrysene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Di-n-butyl phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	--	--	--	--	--	--	--

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Di-n-octyl phthalate	All Surface Soil Samples; All Shallow Soil Samples	8	27	2	7	Tarone-Ware	S	0.04
Dibenz(a,h)anthracene	All Surface Soil Samples; All Shallow Soil Samples	23	77	10	33	Tarone-Ware	S	<0.005
Dibenzofuran	All No Tidal Influenced Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Diethyl phthalate	All samples	1	3	0	0	Tarone-Ware	NS	0.33
Dimethyl phthalate	All samples	1	3	0	0	Tarone-Ware	NS	0.29
Fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Fluorene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Hexachlorobenzene	All samples (all NDs)	--	--	--	--	--	--	--

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Hexachlorobutadiene	All samples	0	0	1	3	Tarone-Ware	NS	0.31
Hexachlorocyclopentadiene	All samples (all NDs)	--	--	--	--	--	--	--
Hexachloroethane	All samples (all NDs)	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Isophorone	All samples (all NDs)	--	--	--	--	--	--	--
N-Nitrosodi-n-propylamine	All samples (all NDs)	--	--	--	--	--	--	--

Attachment A
Table A-2
Means Comparison Results for Data Groupings: Comparing Surface and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	All Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
N-Nitrosodiphenylamine	All samples (all NDs)	--	--	--	--	--	--	--
Naphthalene	All samples	11	37	8	27	Tarone-Ware	NS	0.26
Nitrobenzene	All samples (all NDs)	--	--	--	--	--	--	--
Pentachlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
Phenanthrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--
Phenol	All samples	1	3	0	0	Tarone-Ware	NS	0.29
Pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	--	--	--	--	--	--	--

Notes:

ND = Means Comparison not applicable because the constituent was not detected in any sample for that data group.

-- = No Statistical Test performed due to one of the following factors:

- a.) the constituent was not detected in any sample for that data group;
- b.) a statistically significant difference was detected between Tidally- and Non Tidally-Influenced Samples, so no comparison performed across all samples; or
- c.) no statistical difference was detected between Tidally- and Non Tidally-Influenced Samples, so no comparisons were performed separately for Tidally- and Non Tidally-Influenced Samples.

Attachment A
Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Aluminum	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Antimony	All samples	--	--	--	--	--	--	--
Arsenic	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Barium	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Beryllium	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Boron	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Cadmium	All samples	--	--	--	--	--	--	--
Chromium	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Cobalt	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--

Attachment A
Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Copper	All No Tidal Influenced Samples; All Tidal Influenced Samples	20	100	20	100	Wilcoxon Rank-Sum	NS	0.64
Lead	All samples	--	--	--	--	--	--	--
Manganese	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Nickel	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Selenium	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	20	100	20	100	Normal t-test (equal variances)	S	<0.005
Silver	All No Tidal Influenced Samples; All Tidal Influenced Samples	5	25	5	25	Tarone-Ware	NS	0.89
Thallium	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	6	30	17	85	Tarone-Ware	S	<0.005
Vanadium	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--

Attachment A
Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Zinc	All samples	--	--	--	--	--	--	--
Mercury	All samples	--	--	--	--	--	--	--
4,4'-DDD	All samples	--	--	--	--	--	--	--
4,4'-DDE	All samples	--	--	--	--	--	--	--
4,4'-DDT	All samples	--	--	--	--	--	--	--
Aldrin	All samples	--	--	--	--	--	--	--
Dieldrin	All No Tidal Influenced Samples; All Tidal Influenced Samples	8	40	6	30	Tarone-Ware	NS	0.35
Endosulfan I	All samples	--	--	--	--	--	--	--
Endosulfan II	All samples	--	--	--	--	--	--	--
Endosulfan sulfate	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Endrin	All samples	--	--	--	--	--	--	--
Endrin aldehyde	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Endrin ketone	All samples	--	--	--	--	--	--	--
Heptachlor	All No Tidal Influenced Samples; All Tidal Influenced Samples	5	25	3	15	Tarone-Ware	NS	0.48
Heptachlor epoxide	All No Tidal Influenced Samples; All Tidal Influenced Samples	6	30	5	25	Tarone-Ware	NS	0.75
Methoxychlor	All samples (all NDs)	--	--	--	--	--	--	--
Toxaphene	All samples (all NDs)	--	--	--	--	--	--	--

Attachment A
Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
alpha-BHC	All samples	--	--	--	--	--	--	--
alpha-Chlordane	All samples	--	--	--	--	--	--	--
beta-BHC	All samples	--	--	--	--	--	--	--
delta-BHC	All samples	--	--	--	--	--	--	--
gamma-BHC	All samples	--	--	--	--	--	--	--
gamma-Chlordane	All samples	--	--	--	--	--	--	--
2,4,5-T	All samples (all NDs)	--	--	--	--	--	--	--
2,4,5-TP (Silvex)	All samples	--	--	--	--	--	--	--
2,4-D	All samples	--	--	--	--	--	--	--
2,4-DB	All samples	--	--	--	--	--	--	--
Dalapon	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	1	5	8	40	Tarone-Ware	S	0.01
Dicamba	All samples	--	--	--	--	--	--	--
Dichlorprop	All samples	--	--	--	--	--	--	--
Dinoseb	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	6	30	1	5	Tarone-Ware	S	0.05
MCPA	All samples (all NDs)	--	--	--	--	--	--	--

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Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
MCPP	All samples	--	--	--	--	--	--	--
1,1'-Biphenyl	All samples	--	--	--	--	--	--	--
1,2,4,5-Tetrachlorobenzene	All samples (all NDs)	--	--	--	--	--	--	--
1,4-Dioxane	All samples (all NDs)	--	--	--	--	--	--	--
1-Methylnaphthalene	All samples	--	--	--	--	--	--	--
2,3,4,6-Tetrachlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dichlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dimethylphenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dinitrophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dinitrotoluene	All samples (all NDs)	--	--	--	--	--	--	--
2,6-Dinitrotoluene	All samples (all NDs)	--	--	--	--	--	--	--
2-Chloronaphthalene	All samples (all NDs)	--	--	--	--	--	--	--
2-Chlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2-Methylnaphthalene	All samples	--	--	--	--	--	--	--
2-Methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
2-Nitroaniline	All samples (all NDs)	--	--	--	--	--	--	--
2-Nitrophenol	All samples (all NDs)	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	All samples (all NDs)	--	--	--	--	--	--	--
3-Methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
3-Nitroaniline	All samples (all NDs)	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	All samples (all NDs)	--	--	--	--	--	--	--

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Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
4-Chloro-3-methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
4-Chlorophenyl phenyl ether	All samples (all NDs)	--	--	--	--	--	--	--
4-Methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
4-Nitroaniline	All samples (all NDs)	--	--	--	--	--	--	--
4-Nitrophenol	All samples (all NDs)	--	--	--	--	--	--	--
Acenaphthene	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Acenaphthylene	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Acetophenone	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--

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Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Anthracene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	14	70	5	25	Tarone-Ware	S	<0.005
Atrazine	All samples (all NDs)	--	--	--	--	--	--	--
Benz(a)anthracene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	19	95	10	50	Tarone-Ware	S	<0.005
Benzaldehyde	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Benzo(a)pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	18	90	10	50	Tarone-Ware	S	<0.005

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Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Benzo(b)fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	18	90	10	50	Tarone-Ware	S	<0.005
Benzo(g,h,i)perylene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	15	75	10	50	Tarone-Ware	S	0.03
Benzo(k)fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	19	95	10	50	Tarone-Ware	S	<0.005
Bis(2-chloroethoxy)methane	All samples (all NDs)	--	--	--	--	--	--	--
Bis(2-chloroethyl)ether	All samples (all NDs)	--	--	--	--	--	--	--
Bis(2-chloroisopropyl)ether	All samples (all NDs)	--	--	--	--	--	--	--

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Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Bis(2-ethylhexyl)phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	20	100	12	60	Tarone-Ware	S	<0.005
Butyl benzyl phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	14	70	5	25	Tarone-Ware	S	<0.005
Caprolactam	All samples	--	--	--	--	--	--	--
Carbazole	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	13	65	4	20	Tarone-Ware	S	<0.005

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Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Chrysene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	20	100	11	55	Tarone-Ware	S	<0.005
Di-n-butyl phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	14	70	3	15	Tarone-Ware	S	<0.005
Di-n-octyl phthalate	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Dibenzofuran	All No Tidal Influenced Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	8	40	2	10	Tarone-Ware	NS	0.06
Diethyl phthalate	All samples	--	--	--	--	--	--	--
Dimethyl phthalate	All samples	--	--	--	--	--	--	--

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Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	20	100	11	55	Tarone-Ware	S	<0.005
Fluorene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	11	55	3	15	Tarone-Ware	S	0.01
Hexachlorobenzene	All samples (all NDs)	--	--	--	--	--	--	--
Hexachlorobutadiene	All samples	--	--	--	--	--	--	--
Hexachlorocyclopentadiene	All samples (all NDs)	--	--	--	--	--	--	--
Hexachloroethane	All samples (all NDs)	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	17	85	10	50	Tarone-Ware	S	0.01
Isophorone	All samples (all NDs)	--	--	--	--	--	--	--
N-Nitrosodi-n-propylamine	All samples (all NDs)	--	--	--	--	--	--	--

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Table A-3
Means Comparisons Results for Non Tidally-Influenced Data Groupings:
Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Non Tidally-Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
N-Nitrosodiphenylamine	All samples (all NDs)	--	--	--	--	--	--	--
Naphthalene	All samples	--	--	--	--	--	--	--
Nitrobenzene	All samples (all NDs)	--	--	--	--	--	--	--
Pentachlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
Phenanthrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	16	80	7	35	Tarone-Ware	S	<0.005
Phenol	All samples	--	--	--	--	--	--	--
Pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	20	100	12	60	Tarone-Ware	S	<0.005

Notes:

ND = Means Comparison not applicable because the constituent was not detected in any sample for that data group.

-- = No Statistical Test performed due to one of the following factors:

- a.) the constituent was not detected in any sample for that data group;
- b.) a statistically significant difference was detected between Tidally- and Non Tidally-Influenced Samples, so no comparison performed across all samples; or
- c.) no statistical difference was detected between Tidally- and Non Tidally-Influenced Samples, so no comparisons were performed separately for Tidally- and Non Tidally-Influenced Samples.

Attachment A

Table A-4

**Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site**

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Aluminum	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Antimony	All samples	--	--	--	--	--	--	--
Arsenic	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Barium	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Beryllium	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Boron	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Cadmium	All samples	--	--	--	--	--	--	--
Chromium	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Cobalt	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Copper	All No Tidal Influenced Samples; All Tidal Influenced Samples	10	100	10	100	Wilcoxon Rank-Sum	NS	0.68

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Table A-4

Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Lead	All samples	--	--	--	--	--	--	--
Manganese	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Nickel	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Selenium	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Normal t-test (equal variances)	S	0.02
Silver	All No Tidal Influenced Samples; All Tidal Influenced Samples	5	50	8	80	Tarone-Ware	NS	0.24
Thallium	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	2	20	5	50	Tarone-Ware	NS	0.23
Vanadium	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Zinc	All samples	--	--	--	--	--	--	--
Mercury	All samples	--	--	--	--	--	--	--

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Table A-4
Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
4,4'-DDD	All samples	--	--	--	--	--	--	--
4,4'-DDE	All samples	--	--	--	--	--	--	--
4,4'-DDT	All samples	--	--	--	--	--	--	--
Aldrin	All samples	--	--	--	--	--	--	--
Dieldrin	All No Tidal Influenced Samples; All Tidal Influenced Samples	1	10	0	0	Tarone-Ware	NS	0.32
Endosulfan I	All samples	--	--	--	--	--	--	--
Endosulfan II	All samples	--	--	--	--	--	--	--
Endosulfan sulfate	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Endrin	All samples	--	--	--	--	--	--	--
Endrin aldehyde	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Endrin ketone	All samples	--	--	--	--	--	--	--
Heptachlor	All No Tidal Influenced Samples; All Tidal Influenced Samples	0	0	0	0	--	ND	--
Heptachlor epoxide	All No Tidal Influenced Samples; All Tidal Influenced Samples	0	0	0	0	--	ND	--
Methoxychlor	All samples (all NDs)	--	--	--	--	--	--	--
Toxaphene	All samples (all NDs)	--	--	--	--	--	--	--
alpha-BHC	All samples	--	--	--	--	--	--	--
alpha-Chlordane	All samples	--	--	--	--	--	--	--

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Table A-4

Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
beta-BHC	All samples	--	--	--	--	--	--	--
delta-BHC	All samples	--	--	--	--	--	--	--
gamma-BHC	All samples	--	--	--	--	--	--	--
gamma-Chlordane	All samples	--	--	--	--	--	--	--
2,4,5-T	All samples (all NDs)	--	--	--	--	--	--	--
2,4,5-TP (Silvex)	All samples	--	--	--	--	--	--	--
2,4-D	All samples	--	--	--	--	--	--	--
2,4-DB	All samples	--	--	--	--	--	--	--
Dalapon	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	4	40	6	60	Tarone-Ware	NS	0.63
Dicamba	All samples	--	--	--	--	--	--	--
Dichlorprop	All samples	--	--	--	--	--	--	--
Dinoseb	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	8	80	2	20	Tarone-Ware	S	<0.005
MCPA	All samples (all NDs)	--	--	--	--	--	--	--
MCP	All samples	--	--	--	--	--	--	--
1,1'-Biphenyl	All samples	--	--	--	--	--	--	--
1,2,4,5-Tetrachlorobenzene	All samples (all NDs)	--	--	--	--	--	--	--
1,4-Dioxane	All samples (all NDs)	--	--	--	--	--	--	--

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Table A-4

Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
1-Methylnaphthalene	All samples	--	--	--	--	--	--	--
2,3,4,6-Tetrachlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dichlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dimethylphenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dinitrophenol	All samples (all NDs)	--	--	--	--	--	--	--
2,4-Dinitrotoluene	All samples (all NDs)	--	--	--	--	--	--	--
2,6-Dinitrotoluene	All samples (all NDs)	--	--	--	--	--	--	--
2-Chloronaphthalene	All samples (all NDs)	--	--	--	--	--	--	--
2-Chlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
2-Methylnaphthalene	All samples	--	--	--	--	--	--	--
2-Methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
2-Nitroaniline	All samples (all NDs)	--	--	--	--	--	--	--
2-Nitrophenol	All samples (all NDs)	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	All samples (all NDs)	--	--	--	--	--	--	--
3-Methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
3-Nitroaniline	All samples (all NDs)	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	All samples (all NDs)	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
4-Chlorophenyl phenyl ether	All samples (all NDs)	--	--	--	--	--	--	--

Attachment A

Table A-4

Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
4-Methylphenol	All samples (all NDs)	--	--	--	--	--	--	--
4-Nitroaniline	All samples (all NDs)	--	--	--	--	--	--	--
4-Nitrophenol	All samples (all NDs)	--	--	--	--	--	--	--
Acenaphthene	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Acenaphthylene	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Acetophenone	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Anthracene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	8	80	Normal t-test (equal variances)	S	<0.005
Atrazine	All samples (all NDs)	--	--	--	--	--	--	--
Benz(a)anthracene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Normal t-test (unequal variances)	S	<0.005

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Table A-4

Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Benzaldehyde	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Benzo(a)pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Normal t-test (unequal variances)	S	<0.005
Benzo(b)fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Wilcoxon Rank-Sum	S	<0.005
Benzo(g,h,i)perylene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Normal t-test (unequal variances)	S	<0.005
Benzo(k)fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Normal t-test (unequal variances)	S	<0.005
Bis(2-chloroethoxy)methane	All samples (all NDs)	--	--	--	--	--	--	--
Bis(2-chloroethyl)ether	All samples (all NDs)	--	--	--	--	--	--	--
Bis(2-chloroisopropyl)ether	All samples (all NDs)	--	--	--	--	--	--	--

Attachment A

Table A-4

**Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site**

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Bis(2-ethylhexyl)phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Normal t-test (equal variances)	S	0.02
Butyl benzyl phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	5	50	Tarone-Ware	S	0.01
Caprolactam	All samples	--	--	--	--	--	--	--
Carbazole	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	8	80	Normal t-test (equal variances)	S	<0.005
Chrysene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Normal t-test (unequal variances)	S	<0.005
Di-n-butyl phthalate	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; All Tidal Influenced Samples	7	70	7	70	Normal t-test (equal variances)	NS	0.12
Di-n-octyl phthalate	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--

Attachment A

Table A-4

**Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site**

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Dibenz(a,h)anthracene	All Surface Soil Samples; All Shallow Soil Samples	--	--	--	--	--	--	--
Dibenzofuran	All No Tidal Influenced Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	6	60	4	40	Tarone-Ware	S	0.03
Diethyl phthalate	All samples	--	--	--	--	--	--	--
Dimethyl phthalate	All samples	--	--	--	--	--	--	--
Fluoranthene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Wilcoxon Rank-Sum	S	<0.005
Fluorene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	8	80	4	40	Tarone-Ware	S	0.01
Hexachlorobenzene	All samples (all NDs)	--	--	--	--	--	--	--
Hexachlorobutadiene	All samples	--	--	--	--	--	--	--
Hexachlorocyclopentadiene	All samples (all NDs)	--	--	--	--	--	--	--
Hexachloroethane	All samples (all NDs)	--	--	--	--	--	--	--

Attachment A

Table A-4

Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Indeno(1,2,3-cd)pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	9	90	Normal t-test (equal variances)	S	<0.005
Isophorone	All samples (all NDs)	--	--	--	--	--	--	--
N-Nitrosodi-n-propylamine	All samples (all NDs)	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	All samples (all NDs)	--	--	--	--	--	--	--
Naphthalene	All samples	--	--	--	--	--	--	--
Nitrobenzene	All samples (all NDs)	--	--	--	--	--	--	--
Pentachlorophenol	All samples (all NDs)	--	--	--	--	--	--	--
Phenanthrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Wilcoxon Rank-Sum	S	<0.005
Phenol	All samples	--	--	--	--	--	--	--

Attachment A

Table A-4

**Means Comparisons Results for Tidal Influenced Data Groupings: Comparing Surface Soil and Shallow Soil Samples
Background Soil Study
US Oil Recovery Superfund Site**

Constituent	Data Group	Tidal Influenced Samples: Comparing Surface Soil vs. Shallow Soil						
		Surface Soil (0-0.5 feet)		Shallow Soil (1-2 feet)		Means Comparison		
		# Detects	% Detects	# Detects	% Detects	Test	Conclusion	p-value
Pyrene	No Tidal Influenced, Surface Soil Samples; No Tidal Influenced, Shallow Soil Samples; Tidal Influenced, Surface Soil Samples; Tidal Influenced, Shallow Soil Samples	10	100	10	100	Wilcoxon Rank-Sum	S	<0.005

Notes:

ND = Means Comparison not applicable because the constituent was not detected in any sample for that data group.

-- = No Statistical Test performed due to one of the following factors:

- a.) the constituent was not detected in any sample for that data group;
- b.) a statistically significant difference was detected between Tidally- and Non Tidally-Influenced Samples, so no comparison performed across all samples; or
- c.) no statistical difference was detected between Tidally- and Non Tidally-Influenced Samples, so no comparisons were performed separately for Tidally- and Non Tidally-Influenced Samples.

Attachment B – Outliers

For each data group with more than 60% detected concentrations, an outlier evaluation was performed by identifying potential outliers and testing whether potential outliers were statistical outliers. Box plots and normal probability plots were constructed. EPA Guidance recommends that testing for outliers be performed on background data, but that statistical outliers generally should not be removed unless some basis for a likely error or discrepancy can be identified. Possible errors or discrepancies include “...data recording errors, unusual sampling and laboratory procedures or conditions ...and values significantly outside the historical ranges of background data” (EPA, 2009). “The decision to discard an outlier should be based on some scientific or quality assurance basis.” (EPA, 2000). “The general rule is that a measurement should never be deleted from a data set solely on the basis of an outlier test” (SWDIV, 1999). Furthermore, “a data point should not be eliminated from the background data set simply because it is the highest value that was observed” (EPA, 2002).

Box plots and probability plots are visual techniques used to identify potential outliers. Examples of a box plot and probability plot are provided in Figure B-1. Plots for each data group with more than 60% detected concentrations are provided in Figures B-2 through B-80. Both types of plots demonstrate the patterns and distributions of a data group. The size of the vertical box in a box plot indicates where the middle half of the data fall (i.e., the interquartile range (IQR)). In a probability plot, the tendency for sample concentrations to fall along a straight line indicates a data group’s distribution. For both plot types, sample concentrations that plot further away from the other data points indicate potential outliers. Computational details for both types of plots are found in EPA guidance documents (EPA, 2000; EPA, 2009).

Potential outliers are defined in terms of the IQR, represented by the range of the middle half of the data and indicated by the vertical ‘box’ in a box plot. The IQR is the difference between the upper quartile and the lower quartile of the data. For this evaluation, potential outliers are defined in one of two ways. The first type of potential outlier is any detected concentration that exceeds 1.5 times the IQR, but no more than 3 times the IQR. The second type of potential outlier is any detected concentration greater than 3 times the IQR. EPA, 2009 and EPA, 2017

state that both types of potential outliers should be evaluated with statistical outlier tests.

A statistical outlier test, either the Dixon's test or Rosner's test, was performed for each data group with at least one potential outlier to determine whether the potential outlier was a statistical outlier (Table B-1). For data groups with no more than 25 samples, the Dixon's test was used. For a data group with at least 20 samples, the Rosner's test was used. Dixon's test can only test if one concentration (i.e., the maximum or minimum) is an outlier; the Rosner's test can test if one or more concentrations are outliers (EPA, 2000; EPA, 2002; EPA, 2009). Computational details for these outlier tests are outlined in EPA documents (EPA, 2000; EPA, 2009). Based on results from the statistical outlier tests, potential outliers were classified as statistical outliers.

Both outlier tests assume that the data group without the potential outlier(s) is normally distributed (or lognormally distributed if the data are transformed to the natural-log scale). The normality assumption was checked by running three distributional tests: 1) Shapiro-Wilks test, 2) Kolmogorov-Smirnov test, and 3) PPCC test. These distributional tests are recommended by EPA (EPA, 2000; EPA, 2002; EPA, 2009; EPA, 2017). Each distributional test was run twice:

- Once with the all of the data (detects and not detects), including adjustments made for non-detect concentrations, as described in the Data Preparation section; and
- Once with only the detected data.

Running distributional tests with only detected data follows the procedures in EPA, 2017.

Furthermore, the method used to draw distributional conclusions, which uses the largest p-value from all of the appropriate tests and compares it to a 95% level of significance, was designed to follow ProUCL's distributional recommendations. It should be noted that for data groups with more than 60% and less than 85% detected sample concentrations, the Kolmogorov-Smirnov test could not be performed using all of the data. Also, the Shapiro-Wilks test could not be performed when multiple censoring concentrations for non-detects were present.

If results from any of the six tests (using the Shapiro-Wilks, Kolmogorov-Smirnov, and PPCC tests for all the data and for only the detected data) indicate the data are normally distributed (when the largest p-value is greater than 0.05), the distribution was defined as normal. If none of the six test results indicate normality, the data are tested for lognormality by re-running the six tests with the natural-log transformed data. If results from any of the six tests indicate the data

are lognormally distributed (when the largest p-value is greater than 0.05), the distribution was defined as lognormal. If none of the distributional test results indicate normality and lognormality, no statistical outlier test was performed. Results from these distributional tests are provided in Tables B-2 and B-3 for each constituent and data grouping.

Before the representative background concentrations were calculated (Attachment C), any potential outlier greater than 3 times the IQR that is also defined as a statistical outlier by the outlier test(s) was evaluated for possible errors or data discrepancies. In all cases, no analytical or other quality errors were found, and data were consistent with the range of background concentrations found in the literature for various soils of the United States (EPA, 1995). This is consistent with EPA's recommendation "...that all data not known to be in error should be considered valid" (EPA, 1989). Therefore, no statistical outliers were removed from the background data sets.

The open source, statistical software **R** (The R Foundation, 2017) was used to generate the plots, identify potential outliers, and perform the statistical outlier tests.

ATTACHMENT B TABLES

Attachment B
Table B-1
Results from Statistical Outlier Tests
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	# Detects	# Samples	# Potential Outliers	Outlier Test Performed (# Outliers Tested)	Outlier Test Conclusion
Aluminum	Surface soil (0-0.5 feet) samples	30	30	3	Rosner's Test (3)	Two Largest Observations are Outliers
Arsenic	Shallow soil (1-2 feet) samples	30	30	6	Rosner's Test (6)	Six Largest Detects are Outliers
Arsenic	Surface soil (0-0.5 feet) samples	30	30	2	Rosner's Test (2)	No Statistical Outlier
Barium	Surface soil (0-0.5 feet) samples	30	30	2	Rosner's Test (2)	Maximum Detect is Outlier
Beryllium	Surface soil (0-0.5 feet) samples	30	30	3	Rosner's Test (3)	Two Largest Observations are Outliers
Boron	Surface soil (0-0.5 feet) samples	29	30	1	Rosner's Test (1-Low)	No Statistical Outlier
Cadmium	All samples	51	60	5	Rosner's Test (5)	Five Largest Detects are Outliers
Chromium	Shallow soil (1-2 feet) samples	30	30	1	Rosner's Test (1)	Maximum Detect is Outlier
Cobalt	Surface soil (0-0.5 feet) samples	30	30	4	Rosner's Test (4)	Three Largest Detects are Outliers
Cobalt	Shallow soil (1-2 feet) samples	30	30	5	Rosner's Test (5)	Five Largest Detects are Outliers
Copper	No Tidal Influence samples	40	40	2	Rosner's Test (2)	Maximum Detect is Outlier
Copper	Tidal Influence samples	20	20	3	Dixon's Test (1)	No Outlier Evaluation Performed (Data Not Normal or Lognormal)
Lead	All samples	60	60	3	Rosner's Test (3)	No Statistical Outlier
Manganese	Surface soil (0-0.5 feet) samples	30	30	4	Rosner's Test (3) Rosner's Test (1-Low)	Three Largest Detects are Outliers; No Low Outlier Evaluation Performed (Data Not Normal or Lognormal)
Manganese	Shallow soil (1-2 feet) samples	30	30	1	Rosner's Test (1)	No Statistical Outlier
Nickel	Surface soil (0-0.5 feet) samples	30	30	2	Rosner's Test (2)	No Statistical Outlier
Selenium	No Tidal Influence Surface soil (0-0.5 feet) samples	20	20	1	Dixon's Test (1)	Maximum Detect is Outlier
Silver	Tidal Influence samples	13	20	3	Dixon's Test (1)	No Statistical Outlier
Vanadium	Surface soil (0-0.5 feet) samples	30	30	8	Rosner's Test (5) Rosner's Test (3-Low)	No Outlier Evaluation Performed (Data Not Normal or Lognormal) No Low Outlier Evaluation Performed (Data Not Normal or Lognormal)
Zinc	All samples	60	60	4	Rosner's Test (4)	Three Largest Detects are Outliers
Mercury	All samples	60	60	3	Rosner's Test (3)	Two Largest Observations are Outliers
Acenaphthene	Surface soil (0-0.5 feet) samples	19	30	2	Rosner's Test (2)	Two Largest Observations are Outliers

Attachment B
Table B-1
Results from Statistical Outlier Tests
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Group	# Detects	# Samples	# Potential Outliers	Outlier Test Performed (# Outliers Tested)	Outlier Test Conclusion
Benz(a)anthracene	Tidal Influence Shallow soil (1-2 feet) samples	10	10	1	Dixon's Test (1)	No Statistical Outlier
Benzo(a)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	10	10	1	Dixon's Test (1)	Maximum Detect is Outlier
Benzo(b)fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	10	10	1	Dixon's Test (1)	Maximum Detect is Outlier
Benzo(g,h,i)perylene	Tidal Influence Shallow soil (1-2 feet) samples	10	10	1	Dixon's Test (1)	Maximum Detect is Outlier
Benzo(g,h,i)perylene	Tidal Influence Surface soil (0-0.5 feet) samples	10	10	1	Dixon's Test (1)	Maximum Detect is Outlier
Bis(2-ethylhexyl)phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	20	20	1	Dixon's Test (1)	Maximum Detect is Outlier
Bis(2-ethylhexyl)phthalate	Tidal Influence Shallow soil (1-2 feet) samples	10	10	2	Dixon's Test (1)	No Statistical Outlier
Bis(2-ethylhexyl)phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	10	10	1	Dixon's Test (1)	Maximum Detect is Outlier
Butyl benzyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	14	20	2	Dixon's Test (1)	No Statistical Outlier
Butyl benzyl phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	10	10	1	Dixon's Test (1)	Maximum Detect is Outlier
Carbazole	Tidal Influence Shallow soil (1-2 feet) samples	8	10	1	Dixon's Test (1)	Maximum Detect is Outlier
Di-n-butyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	14	20	2	Dixon's Test (1)	Maximum Detect is Outlier
Di-n-butyl phthalate	Tidal Influence samples	14	20	1	Dixon's Test (1)	No Statistical Outlier
Fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	10	10	2	Dixon's Test (1)	No Statistical Outlier
Indeno(1,2,3-cd)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	9	10	1	Dixon's Test (1)	Maximum Detect is Outlier
Indeno(1,2,3-cd)pyrene	Tidal Influence Surface soil (0-0.5 feet) samples	10	10	1	Dixon's Test (1)	Maximum Detect is Outlier
Phenanthrene	No Tidal Influence Surface soil (0-0.5 feet) samples	16	20	1	Dixon's Test (1)	No Statistical Outlier
Phenanthrene	Tidal Influence Shallow soil (1-2 feet) samples	10	10	1	Dixon's Test (1)	No Statistical Outlier
Pyrene	Tidal Influence Shallow soil (1-2 feet) samples	10	10	2	Dixon's Test (1)	No Statistical Outlier

Attachment B
Table B-2
Results from Tests for Normality
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Set	Outlier Test (# Outliers Tested)	p-values for						Is Distribution without Outlier(s)	Conclusion
			Kolmogorov-Smirnov Test		Shapiro-Wilks Test		Probability Plot Correlation			
			All Data	Detected Data	All Data	Detected Data	All Data	Detected Data		
Aluminum	Surface soil (0-0.5 feet) samples	Rosner's Test (3)	0.20	0.20	0.09	0.09	0.08	0.08	Yes	2 of 3 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Arsenic	Shallow soil (1-2 feet) samples	Rosner's Test (6)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	Rosner Test Not Performed (data not Normal)
Arsenic	Surface soil (0-0.5 feet) samples	Rosner's Test (2)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	Rosner Test Not Performed (data not Normal)
Barium	Surface soil (0-0.5 feet) samples	Rosner's Test (2)	0.09	0.09	0.17	0.17	0.17	0.17	Yes	1 of 2 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Beryllium	Surface soil (0-0.5 feet) samples	Rosner's Test (3)	0.17	0.17	0.29	0.29	0.23	0.23	Yes	2 of 3 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Boron	Surface soil (0-0.5 feet) samples	Rosner's Test (1-Low)	0.37	0.58	0.59	0.73	0.50	0.61	Yes	No Outlier(s) based on Rosner's Test (Normal)
Cadmium	All samples	Rosner's Test (5)	NC	0.04	NC	0.03	0.26	0.04	Yes	5 of 5 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Chromium	Shallow soil (1-2 feet) samples	Rosner's Test (1)	0.37	0.37	0.74	0.74	0.48	0.48	Yes	1 of 1 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Cobalt	Shallow soil (1-2 feet) samples	Rosner's Test (5)	0.64	0.64	0.10	0.10	0.11	0.11	Yes	5 of 5 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Cobalt	Surface soil (0-0.5 feet) samples	Rosner's Test (4)	0.15	0.15	0.21	0.21	0.12	0.12	Yes	3 of 4 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Copper	No Tidal Influence samples	Rosner's Test (2)	0.30	0.30	0.19	0.19	0.13	0.13	Yes	1 of 2 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Copper	Tidal Influence samples	Dixon's Test (1)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	Dixon Test Not Performed (data not Normal)
Lead	All samples	Rosner's Test (3)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	Rosner Test Not Performed (data not Normal)
Manganese	Shallow soil (1-2 feet) samples	Rosner's Test (1)	0.06	0.06	0.01	0.01	0.02	0.02	Yes	No Outlier(s) based on Rosner's Test (Normal)
Manganese	Surface soil (0-0.5 feet) samples	Rosner's Test (3)	0.07	0.07	0.04	0.04	0.05	0.05	Yes	3 of 3 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Manganese	Surface soil (0-0.5 feet) samples	Rosner's Test (1-Low)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	Rosner Test Not Performed (data not Normal)
Nickel	Surface soil (0-0.5 feet) samples	Rosner's Test (2)	0.53	0.53	0.53	0.53	0.38	0.38	Yes	No Outlier(s) based on Rosner's Test (Normal)

Attachment B
Table B-2
Results from Tests for Normality
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Set	Outlier Test (# Outliers Tested)	p-values for						Is Distribution without Outlier(s)	Conclusion
			Kolmogorov-Smirnov Test		Shapiro-Wilks Test		Probability Plot Correlation			
			All Data	Detected Data	All Data	Detected Data	All Data	Detected Data		
Selenium	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	0.82	0.82	0.84	0.84	0.85	0.85	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Silver	Tidal Influence samples	Dixon's Test (1)	NC	0.02	NC	0.01	0.06	0.01	Yes	Not an Maximum Detect is Outlier based on Dixon Tes (Normal)
Vanadium	Surface soil (0-0.5 feet) samples	Rosner's Test (5)	<0.005	<0.005	0.01	0.01	0.01	0.01	No	Rosner Test Not Performed (data not Normal)
Vanadium	Surface soil (0-0.5 feet) samples	Rosner's Test (3-Low)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	Rosner Test Not Performed (data not Normal)
Zinc	All samples	Rosner's Test (4)	0.56	0.56	0.17	0.17	0.14	0.14	Yes	3 of 4 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Mercury	All samples	Rosner's Test (3)	0.05	0.05	<0.005	<0.005	0.01	0.01	Yes	2 of 3 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Acenaphthene	Surface soil (0-0.5 feet) samples	Rosner's Test (2)	NC	0.01	NC	0.05	0.48	0.06	Yes	2 of 2 Largest Observations are Outlier(s) based on Rosner's Test (Normal)
Benz(a)anthracene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.03	0.03	0.03	0.03	0.03	0.03	No	Dixon Test Not Performed (data not Normal)
Benzo(a)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.08	0.08	0.15	0.15	0.16	0.16	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Benzo(b)fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.25	0.25	0.05	0.05	0.04	0.04	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Benzo(g,h,i)perylene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.38	0.38	0.19	0.19	0.29	0.29	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Benzo(g,h,i)perylene	Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	0.10	0.10	0.21	0.21	0.24	0.24	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Bis(2-ethylhexyl)phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	0.19	0.19	0.01	0.01	0.01	0.01	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Bis(2-ethylhexyl)phthalate	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.56	0.56	0.70	0.70	0.86	0.86	Yes	Not an Maximum Detect is Outlier based on Dixon Test (Normal)
Bis(2-ethylhexyl)phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	0.84	0.84	0.45	0.45	0.62	0.62	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Butyl benzyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	NC	0.01	NC	<0.005	<0.005	<0.005	No	Dixon Test Not Performed (data not Normal)
Butyl benzyl phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	0.93	0.93	0.98	0.98	0.98	0.98	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)

Attachment B
Table B-2
Results from Tests for Normality
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Set	Outlier Test (# Outliers Tested)	p-values for						Is Distribution without Outlier(s)	
			Kolmogorov-Smirnov Test		Shapiro-Wilks Test		Probability Plot Correlation			Conclusion
			All Data	Detected Data	All Data	Detected Data	All Data	Detected Data		
Carbazole	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	NC	0.30	NC	0.14	0.47	0.14	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Di-n-butyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	NC	0.14	NC	0.02	0.04	0.01	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Di-n-butyl phthalate	Tidal Influence samples	Dixon's Test (1)	NC	0.18	NC	0.04	0.36	0.07	Yes	Not an Maximum Detect is Outlier based on Dixon Test (Normal)
Fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	Dixon Test Not Performed (data not Normal)
Indeno(1,2,3-cd)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.22	0.30	0.27	0.21	0.23	0.19	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Indeno(1,2,3-cd)pyrene	Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	0.24	0.24	0.24	0.24	0.26	0.26	Yes	Maximum Detect is Outlier based on Dixon Test (Normal)
Phenanthrene	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	NC	0.48	NC	0.12	0.56	0.18	Yes	Not an Maximum Detect is Outlier based on Dixon Test (Normal)
Phenanthrene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.01	0.01	0.03	0.03	0.04	0.04	No	Dixon Test Not Performed (data not Normal)
Pyrene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.04	0.04	<0.005	<0.005	0.01	0.01	No	Dixon Test Not Performed (data not Normal)

Notes:

NC = Kolmogorov-Smirnov test not calculated if there were fewer than 85% detects; Shapiro-Wilks test not calculated if there were multiple censoring values for non-detects

Table B-3
Results from Tests for Lognormality
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Set	Outlier Test (# Outliers Tested)	p-values for Distributional Tests - Lognormality						Is Distribution without Outlier(s) Lognormal?	Conclusion
			Kolmogorov-Smirnov Test		Shapiro-Wilks Test		Probability Plot Correlation Coefficient Test			
			All Data	Detected Data	All Data	Detected Data	All Data	Detected Data		
Aluminum	Surface soil (0-0.5 feet) samples	Rosner's Test (3)	--	--	--	--	--	--	--	--
Arsenic	Shallow soil (1-2 feet) samples	Rosner's Test (6)	0.12	0.12	0.27	0.27	0.15	0.15	Yes	6 of 6 Largest Observations are Outlier(s) based on Rosner's Test (Lognormal)
Arsenic	Surface soil (0-0.5 feet) samples	Rosner's Test (2)	0.07	0.07	0.40	0.40	0.25	0.25	Yes	No Outlier(s) based on Rosner's Test (Lognormal)
Barium	Surface soil (0-0.5 feet) samples	Rosner's Test (2)	--	--	--	--	--	--	--	--
Beryllium	Surface soil (0-0.5 feet) samples	Rosner's Test (3)	--	--	--	--	--	--	--	--
Boron	Surface soil (0-0.5 feet) samples	Rosner's Test (1-Low)	--	--	--	--	--	--	--	--
Cadmium	All samples	Rosner's Test (5)	--	--	--	--	--	--	--	--
Chromium	Shallow soil (1-2 feet) samples	Rosner's Test (1)	--	--	--	--	--	--	--	--
Cobalt	Shallow soil (1-2 feet) samples	Rosner's Test (5)	--	--	--	--	--	--	--	--
Cobalt	Surface soil (0-0.5 feet) samples	Rosner's Test (4)	--	--	--	--	--	--	--	--
Copper	No Tidal Influence samples	Rosner's Test (2)	--	--	--	--	--	--	--	--
Copper	Tidal Influence samples	Dixon's Test (1)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	No	Dixon Test Not Performed (data not Lognormal)
Lead	All samples	Rosner's Test (3)	0.79	0.79	0.29	0.29	0.22	0.22	Yes	No Outlier(s) based on Rosner's Test (Lognormal)
Manganese	Shallow soil (1-2 feet) samples	Rosner's Test (1)	--	--	--	--	--	--	--	--
Manganese	Surface soil (0-0.5 feet) samples	Rosner's Test (3)	--	--	--	--	--	--	--	--
Manganese	Surface soil (0-0.5 feet) samples	Rosner's Test (1-Low)	<0.005	<0.005	0.01	0.01	<0.005	<0.005	No	Rosner Test Not Performed (data not Lognormal)
Nickel	Surface soil (0-0.5 feet) samples	Rosner's Test (2)	--	--	--	--	--	--	--	--
Selenium	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--

Table B-3
Results from Tests for Lognormality
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Set	Outlier Test (# Outliers Tested)	p-values for Distributional Tests - Lognormality						Is Distribution without Outlier(s) Lognormal?	Conclusion
			Kolmogorov-Smirnov Test		Shapiro-Wilks Test		Probability Plot Correlation Coefficient Test			
			All Data	Detected Data	All Data	Detected Data	All Data	Detected Data		
Silver	Tidal Influence samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Vanadium	Surface soil (0-0.5 feet) samples	Rosner's Test (5)	0.01	0.01	0.02	0.02	0.02	0.02	No	Rosner Test Not Performed (data not Lognormal)
Vanadium	Surface soil (0-0.5 feet) samples	Rosner's Test (3-Low)	0.01	0.01	0.02	0.02	0.02	0.02	No	Rosner Test Not Performed (data not Lognormal)
Zinc	All samples	Rosner's Test (4)	--	--	--	--	--	--	--	--
Mercury	All samples	Rosner's Test (3)	--	--	--	--	--	--	--	--
Acenaphthene	Surface soil (0-0.5 feet) samples	Rosner's Test (2)	--	--	--	--	--	--	--	--
Benz(a)anthracene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.14	0.14	0.45	0.45	0.55	0.55	Yes	Not an Outlier based on Dixon Test (Lognormal)
Benzo(a)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	NC	0.79	NC	0.59	0.66	0.64	Yes	Not an Outlier based on Dixon Test (Lognormal)
Butyl benzyl phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Carbazole	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	Tidal Influence samples	Dixon's Test (1)	--	--	--	--	--	--	--	--

Table B-3
Results from Tests for Lognormality
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Set	Outlier Test (# Outliers Tested)	p-values for Distributional Tests - Lognormality						Is Distribution without Outlier(s) Lognormal?	Conclusion
			Kolmogorov-Smirnov Test		Shapiro-Wilks Test		Probability Plot Correlation Coefficient Test			
			All Data	Detected Data	All Data	Detected Data	All Data	Detected Data		
Fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.04	0.04	0.15	0.15	0.15	0.15	Yes	Not an Outlier based on Dixon Test (Lognormal)
Indeno(1,2,3-cd)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Phenanthrene	No Tidal Influence Surface soil (0-0.5 feet) samples	Dixon's Test (1)	--	--	--	--	--	--	--	--
Phenanthrene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.01	0.01	0.09	0.09	0.12	0.12	Yes	Not an Outlier based on Dixon Test (Lognormal)
Pyrene	Tidal Influence Shallow soil (1-2 feet) samples	Dixon's Test (1)	0.35	0.35	0.45	0.45	0.48	0.48	Yes	Not an Outlier based on Dixon Test (Lognormal)

Notes:

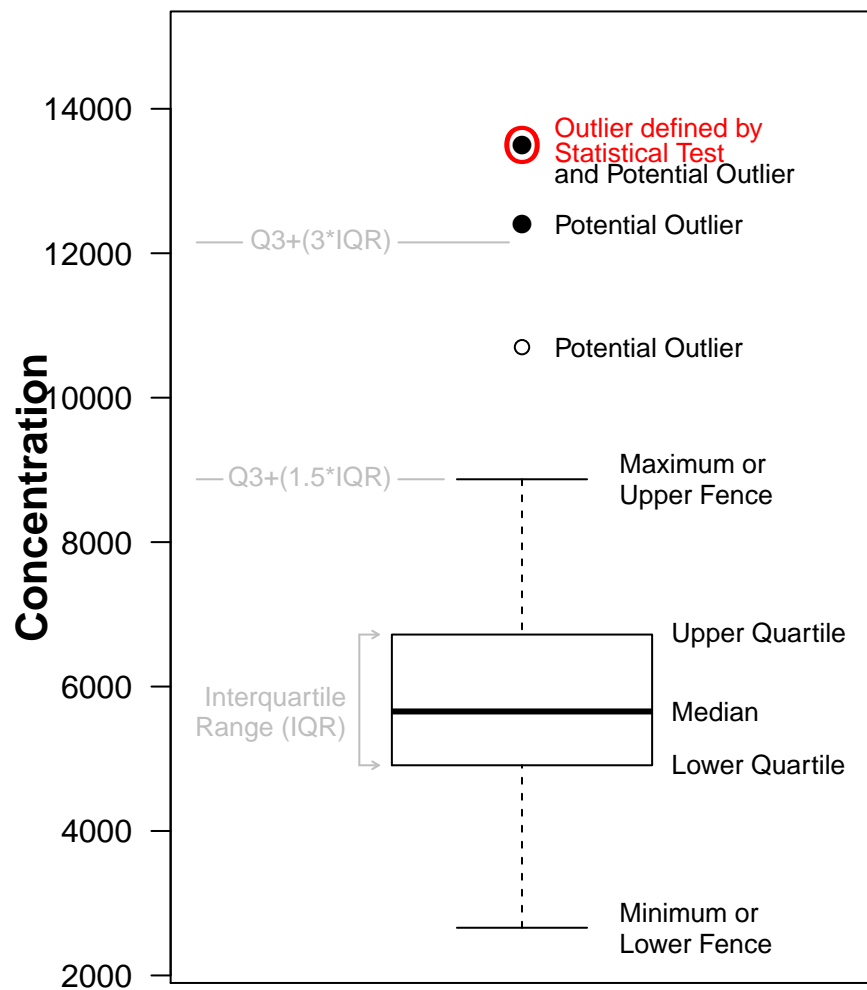
-- = Tests not performed because normality assumption is reasonable.

NC = Kolmogorov-Smirnov test not calculated if there were fewer than 85% detects; Shapiro-Wilks test not calculated if there were multiple censoring values for non-detects

ATTACHMENT B FIGURES

Figure B-1. Example Plots

Example Box Plot



Example Normal Probability Plot

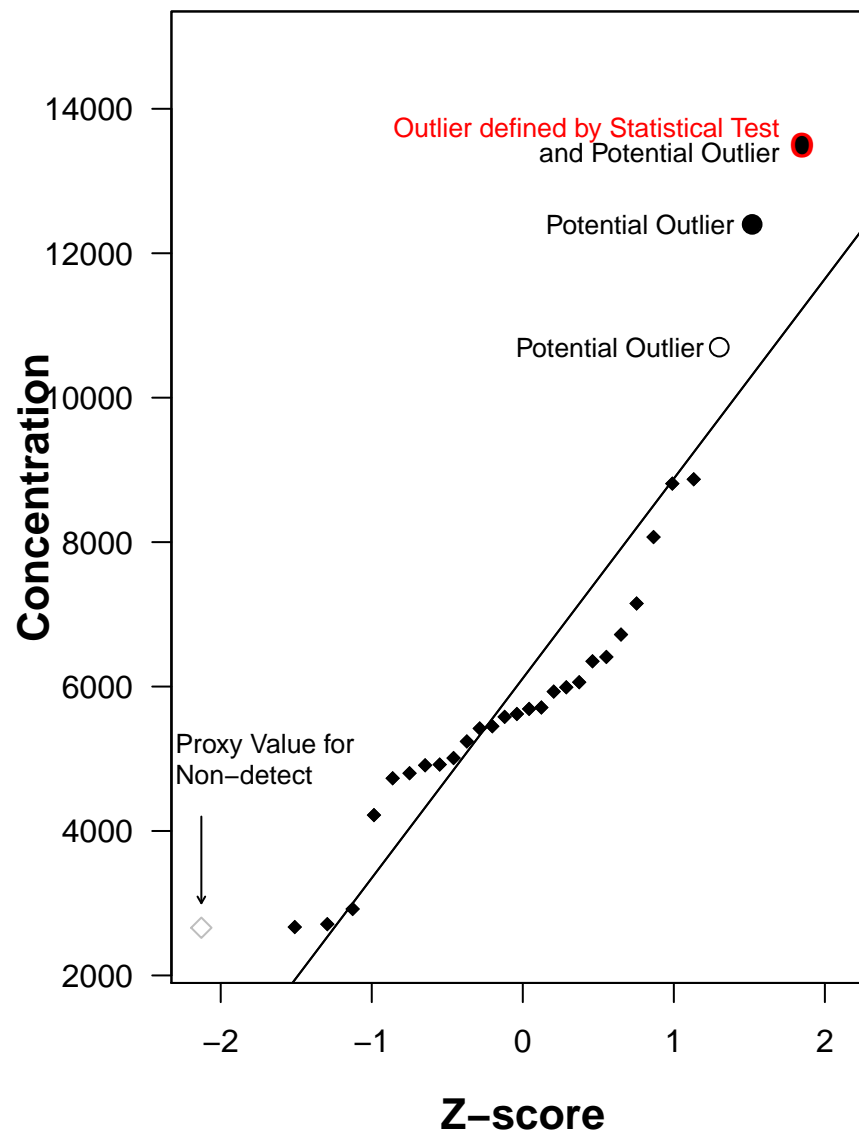
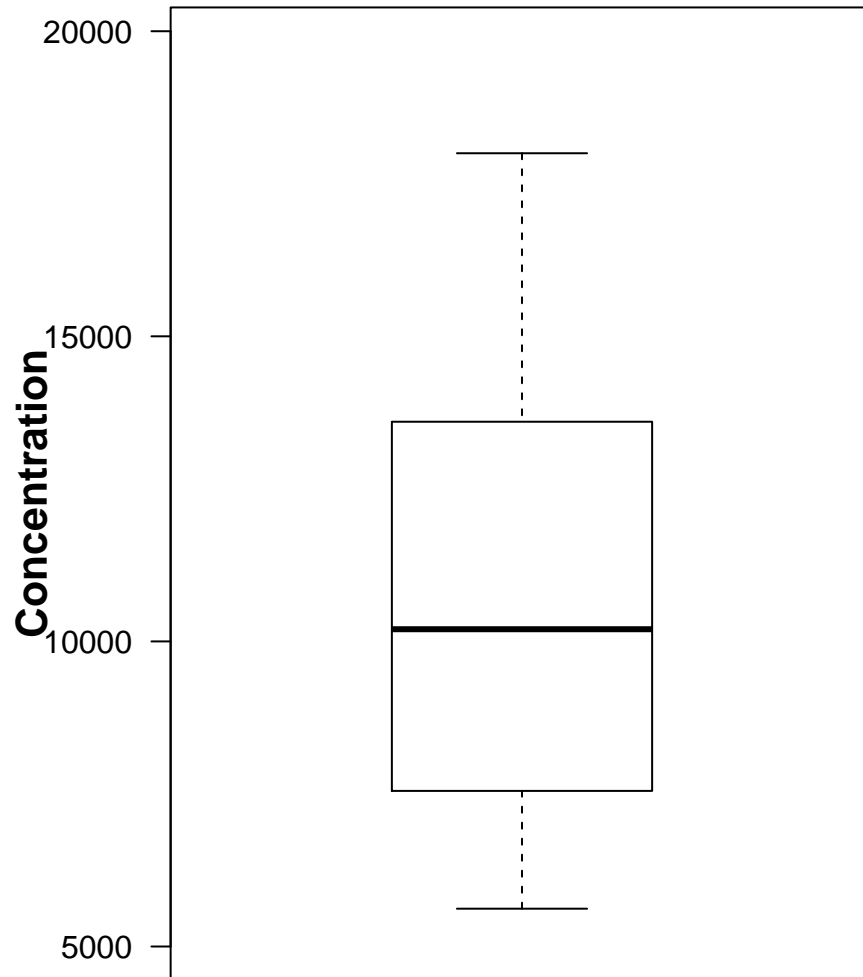


Figure B-2. SW6020, Aluminum (mg/Kg)

Shallow soil (1-2 feet) samples

Det/N=30/30, Normal

Box Plot



Normal Probability Plot

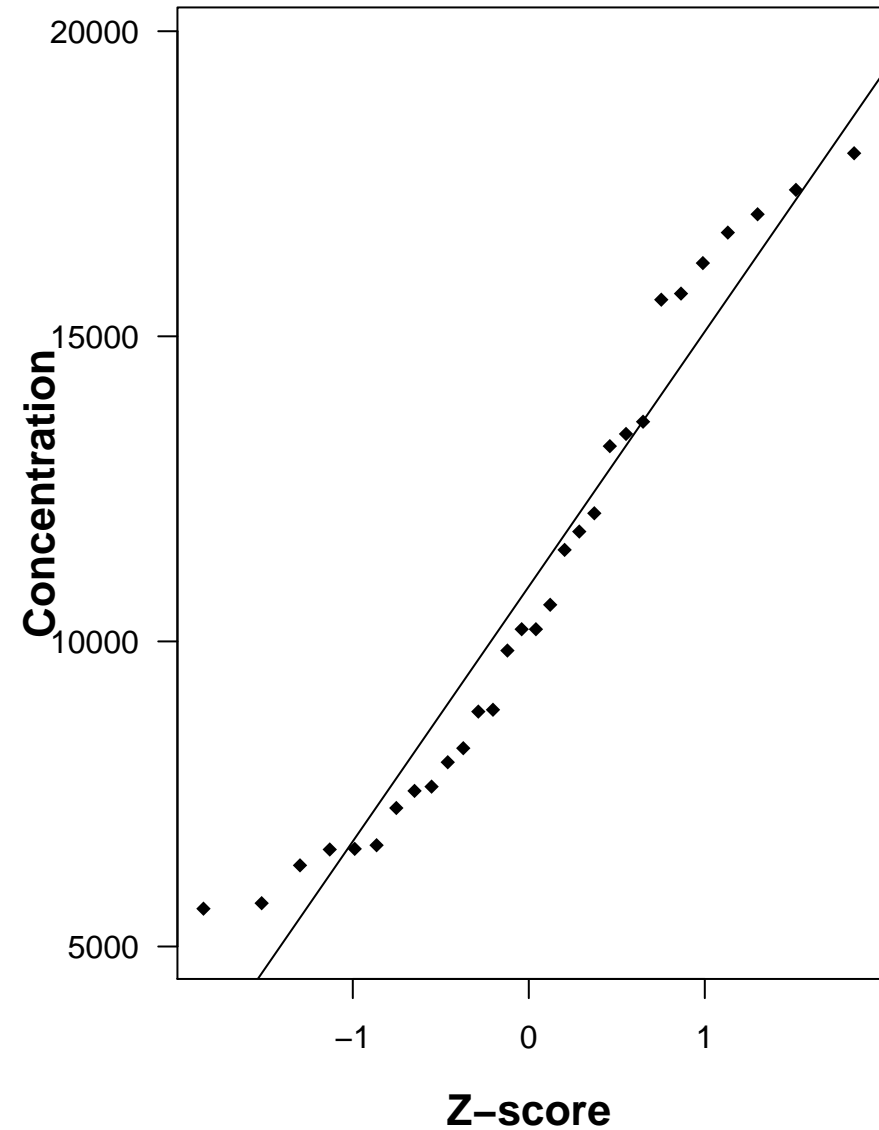
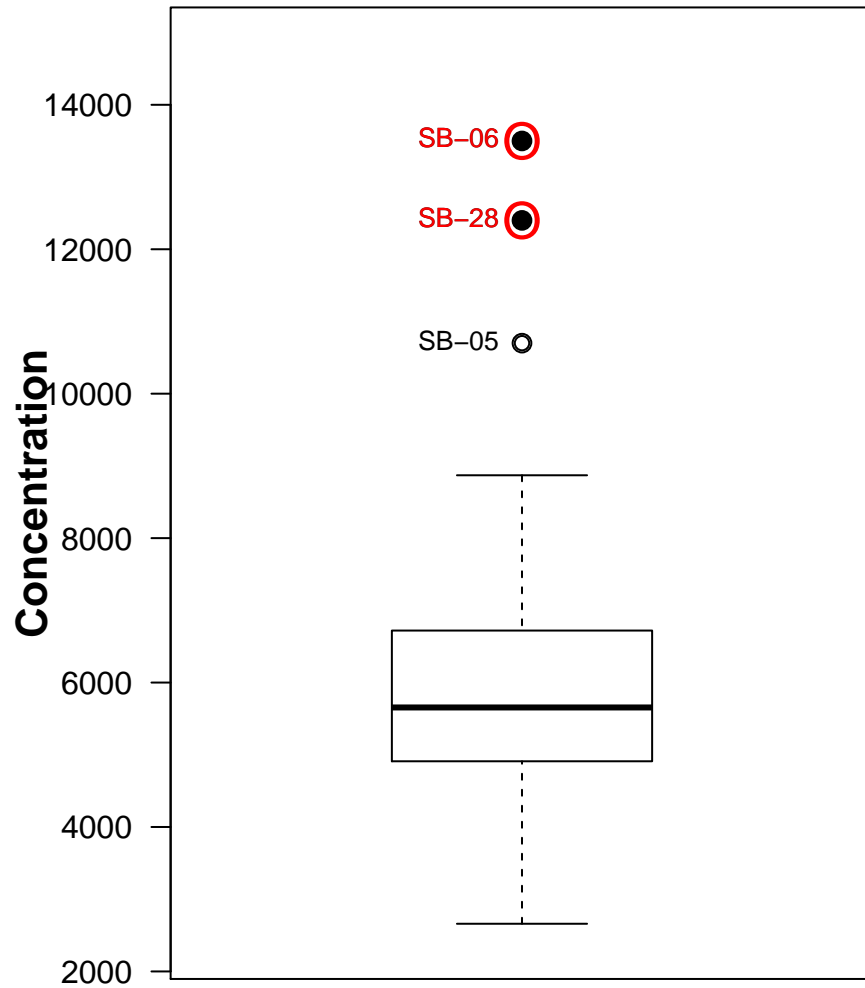


Figure B-3. SW6020, Aluminum (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=30/30, Gamma

Box Plot



Normal Probability Plot

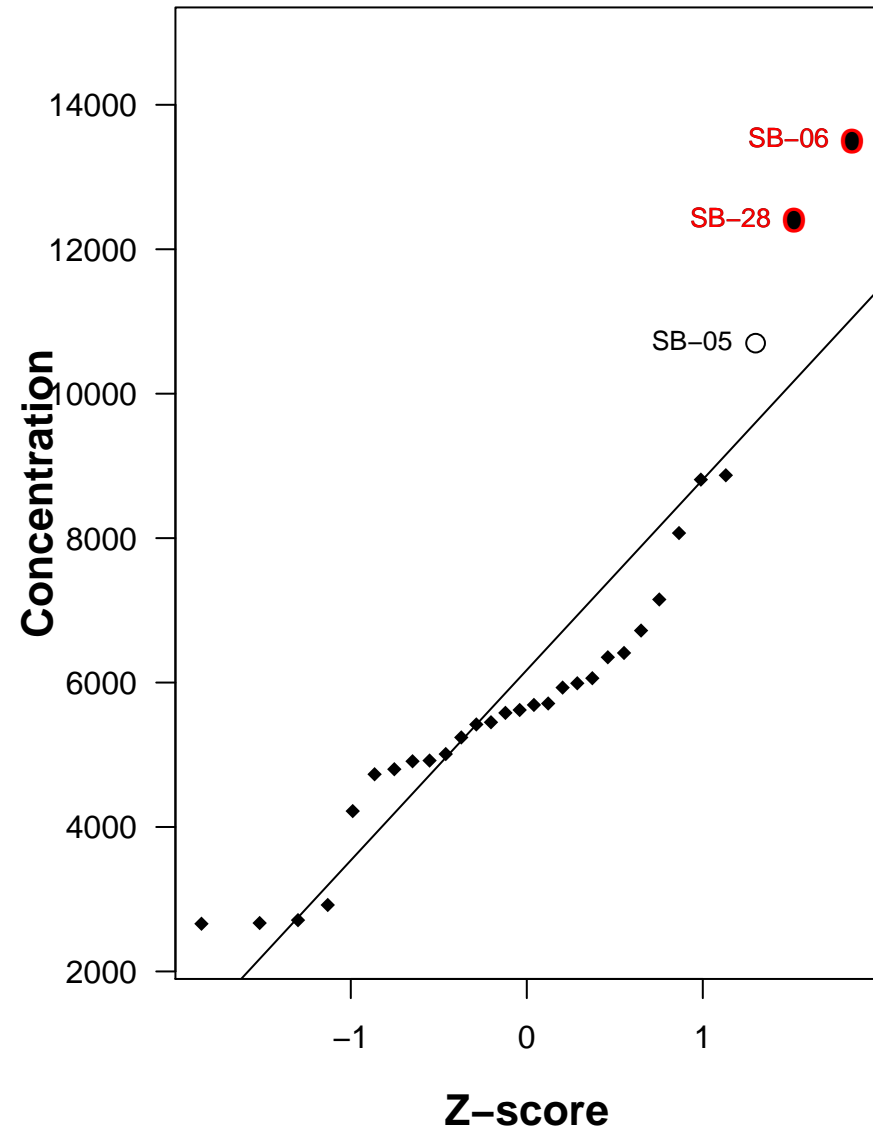
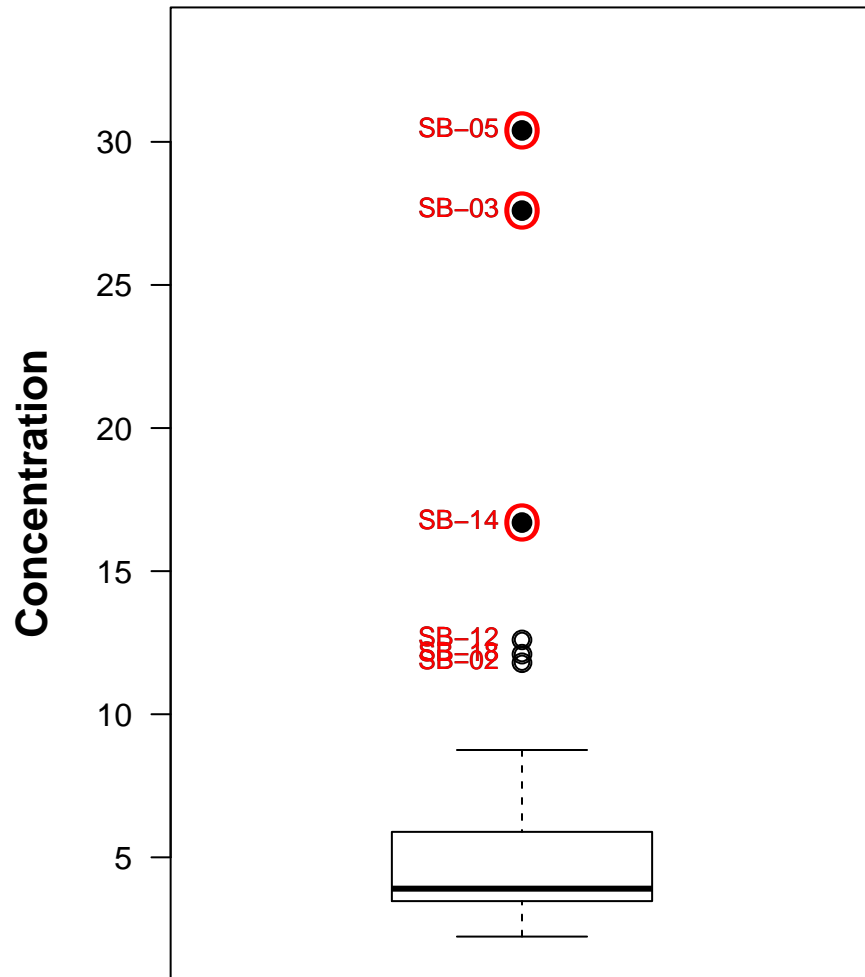


Figure B-4. SW6020, Arsenic (mg/Kg)

Shallow soil (1–2 feet) samples

Det/N=30/30, Nonparametric

Box Plot



Normal Probability Plot

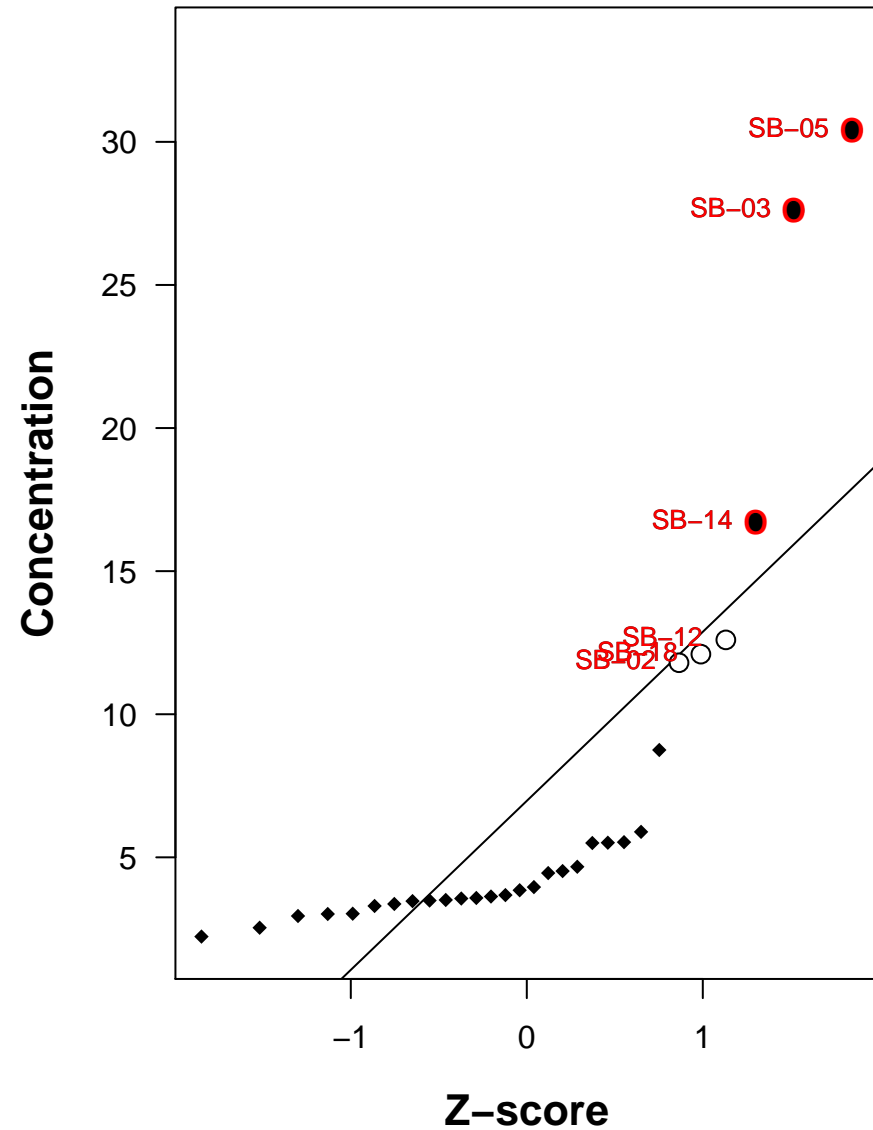
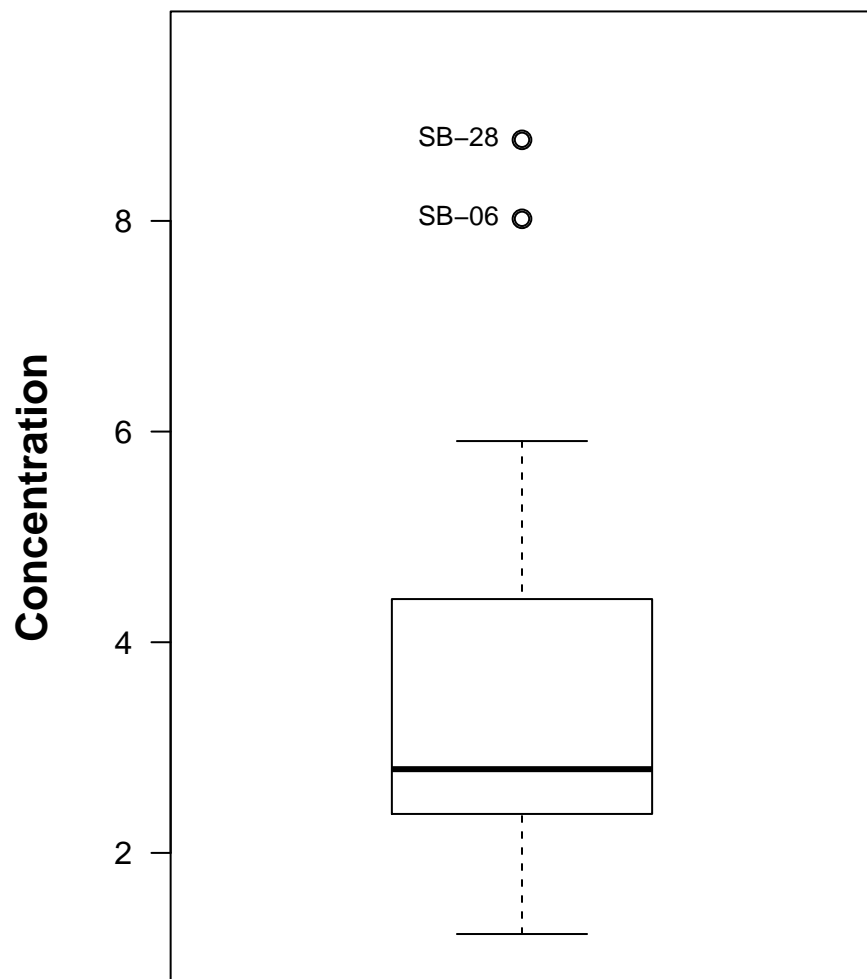


Figure B-5. SW6020, Arsenic (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=30/30, Gamma

Box Plot



Normal Probability Plot

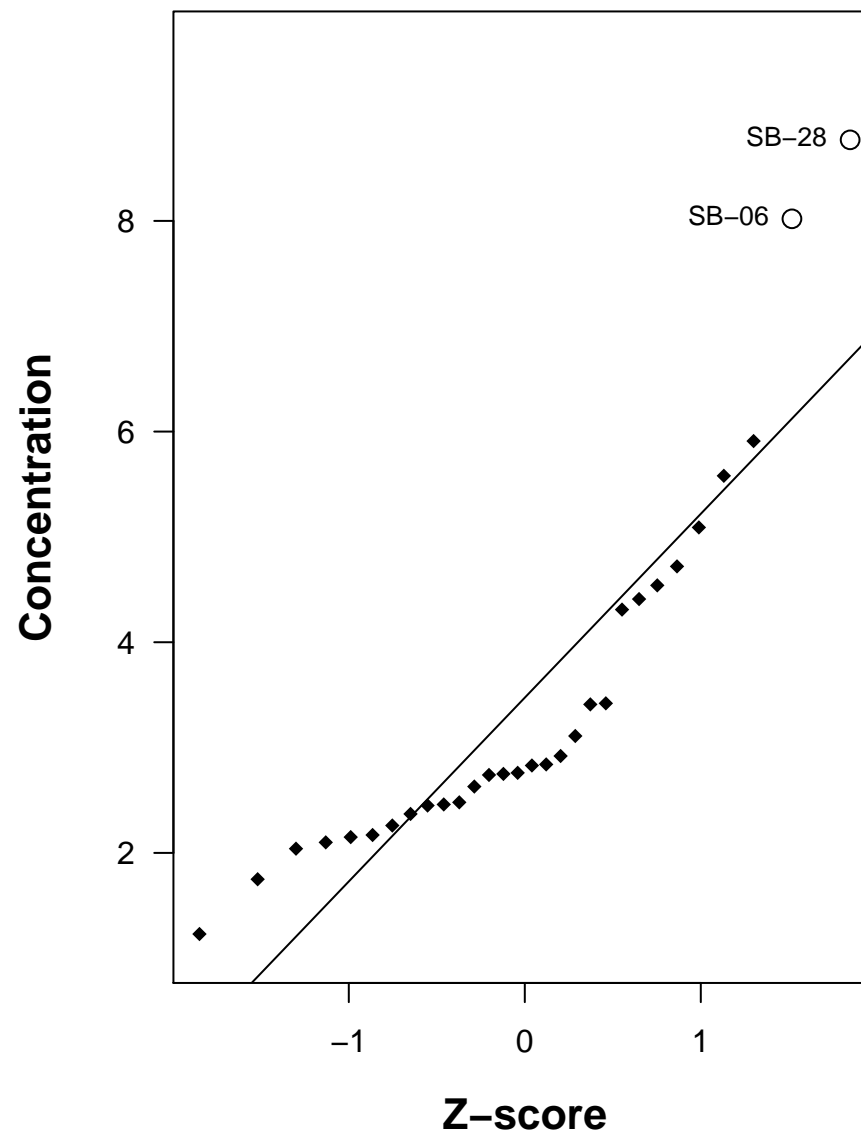
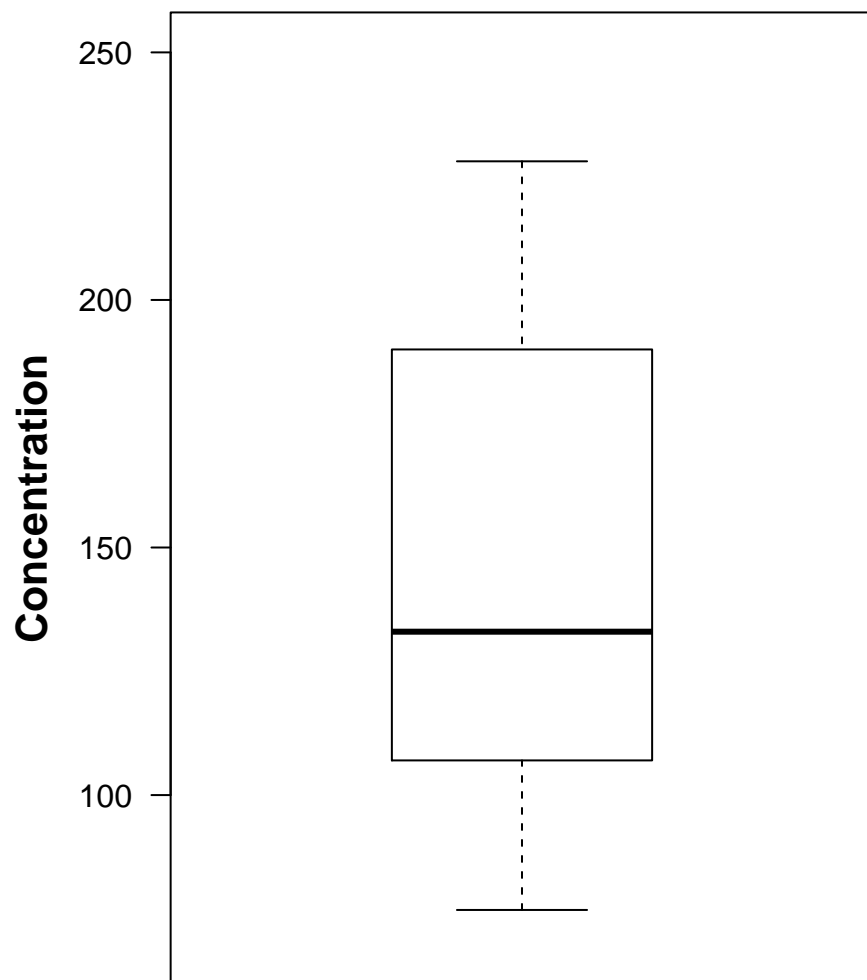


Figure B-6. SW6020, Barium (mg/Kg)

Shallow soil (1-2 feet) samples

Det/N=30/30, Normal

Box Plot



Normal Probability Plot

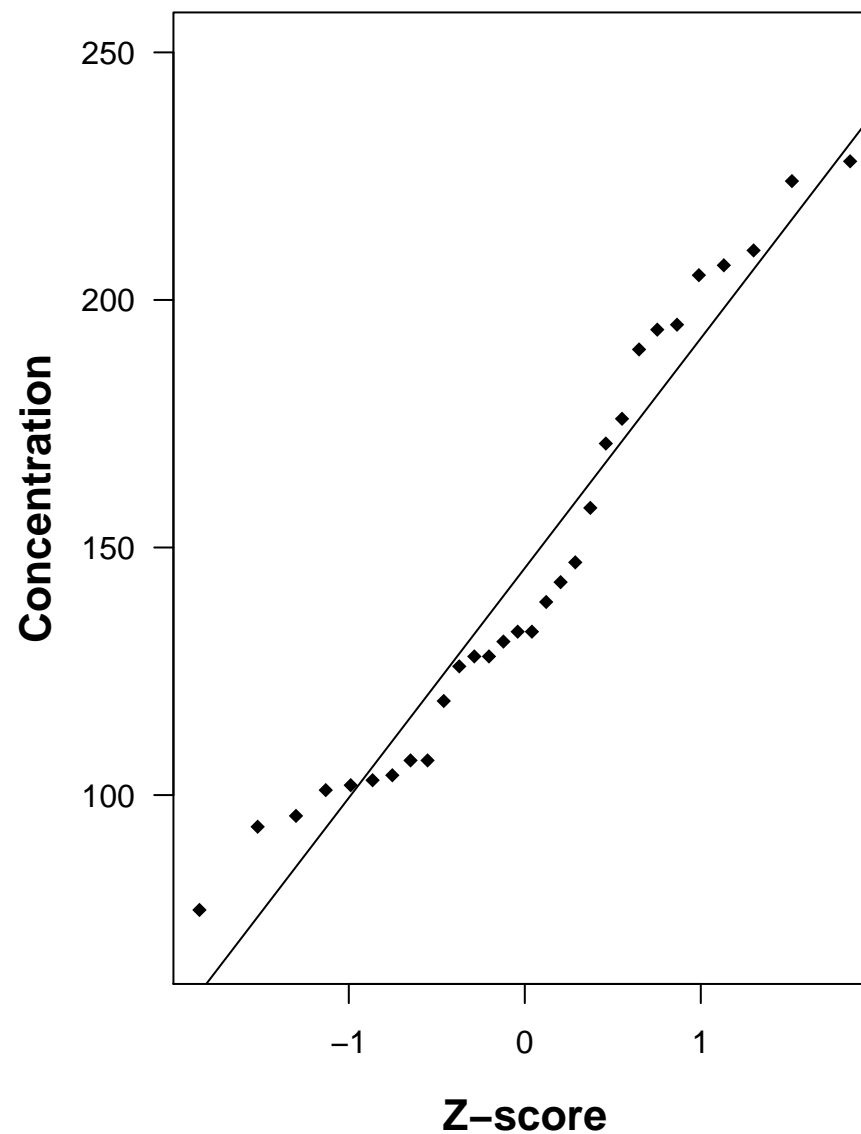
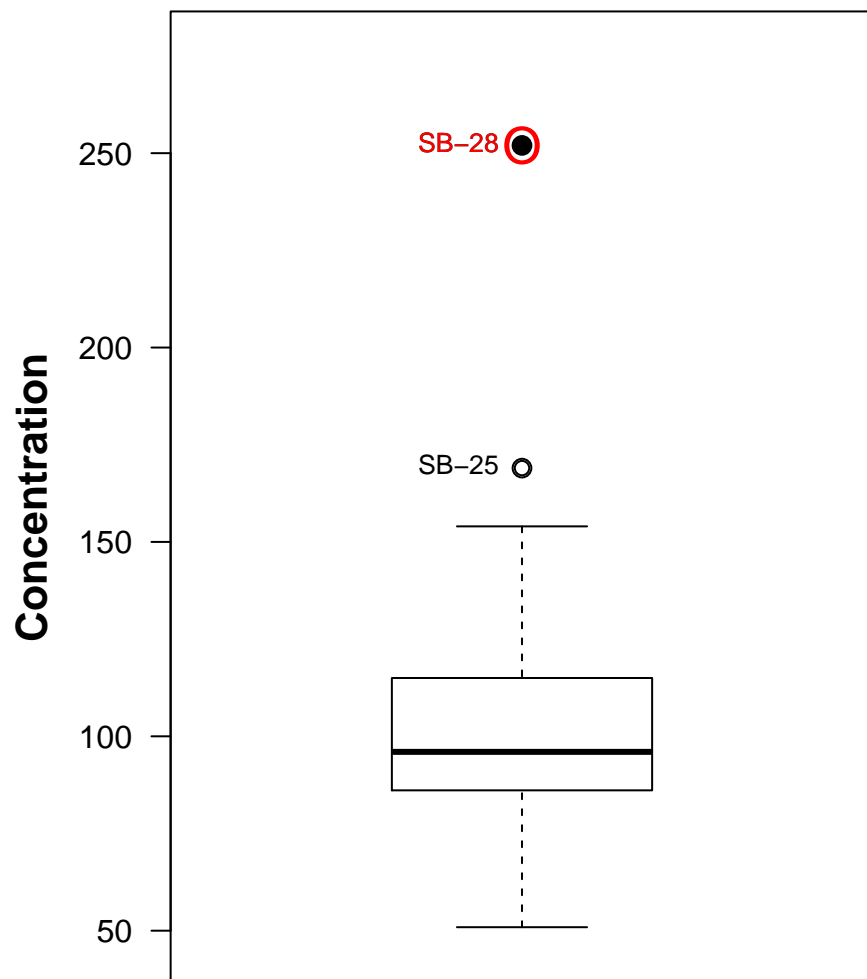


Figure B-7. SW6020, Barium (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=30/30, Gamma

Box Plot



Normal Probability Plot

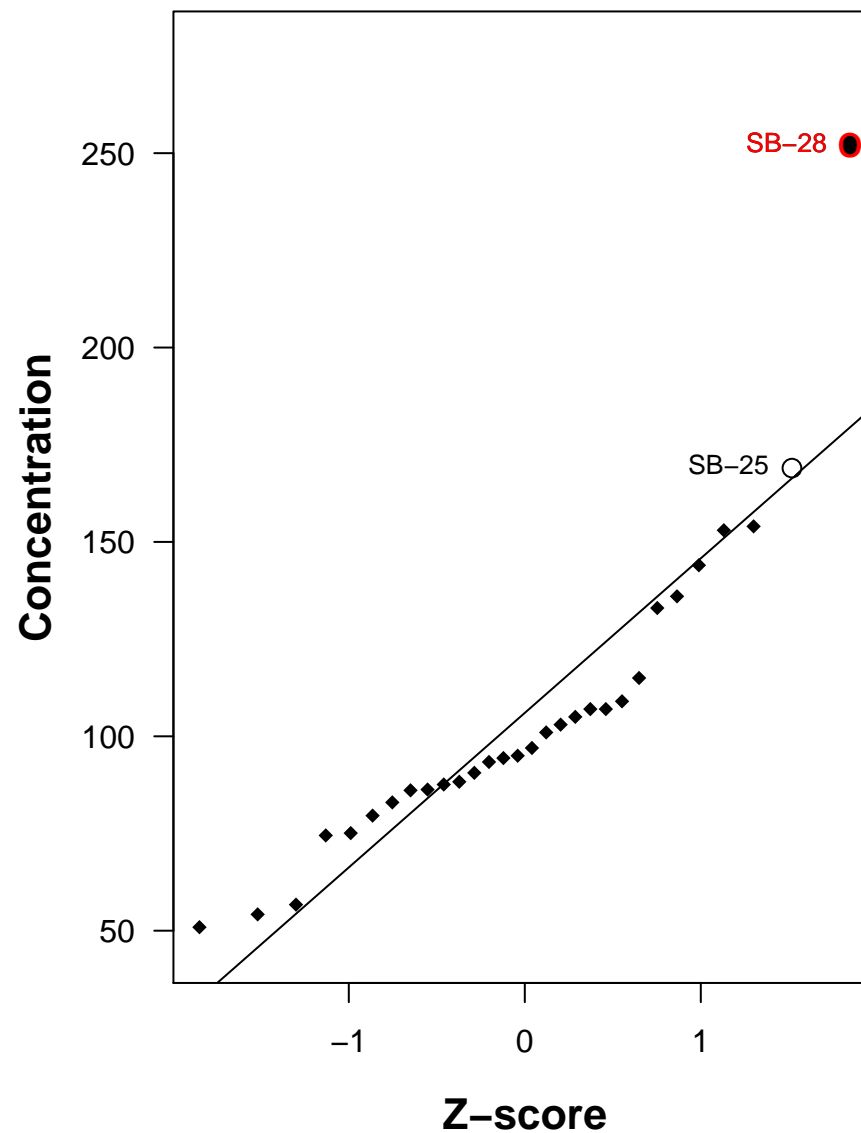
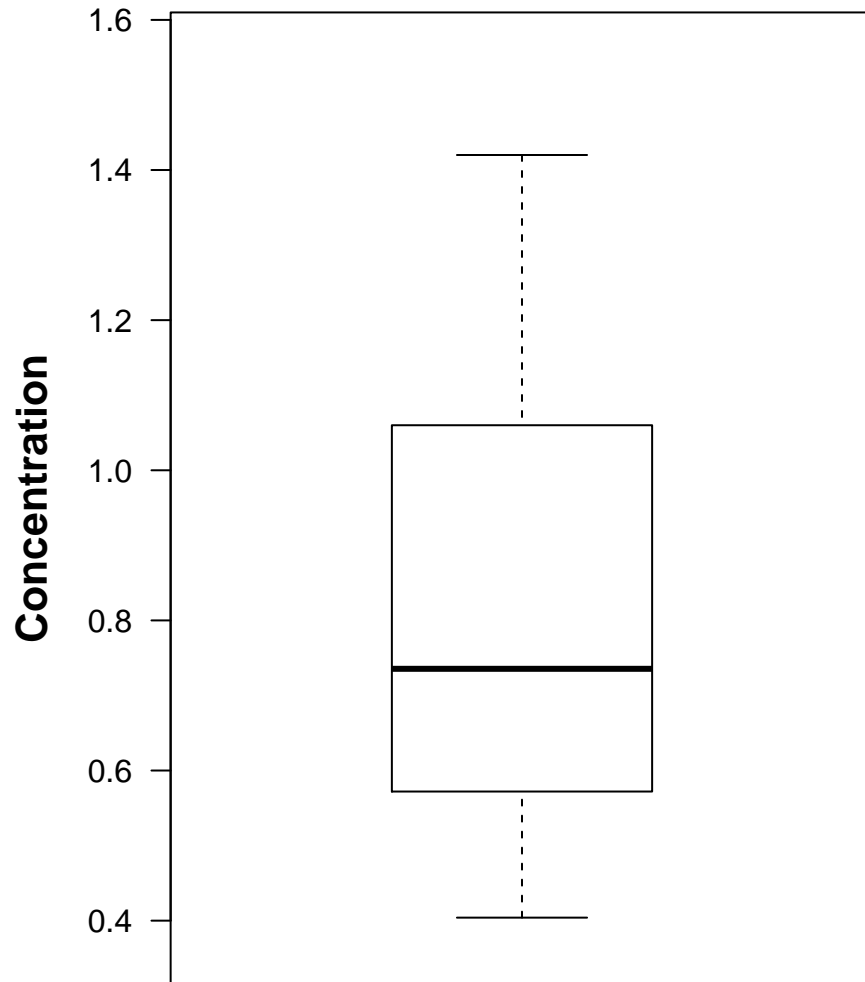


Figure B-8. SW6020, Beryllium (mg/Kg)

Shallow soil (1-2 feet) samples

Det/N=30/30, Normal

Box Plot



Normal Probability Plot

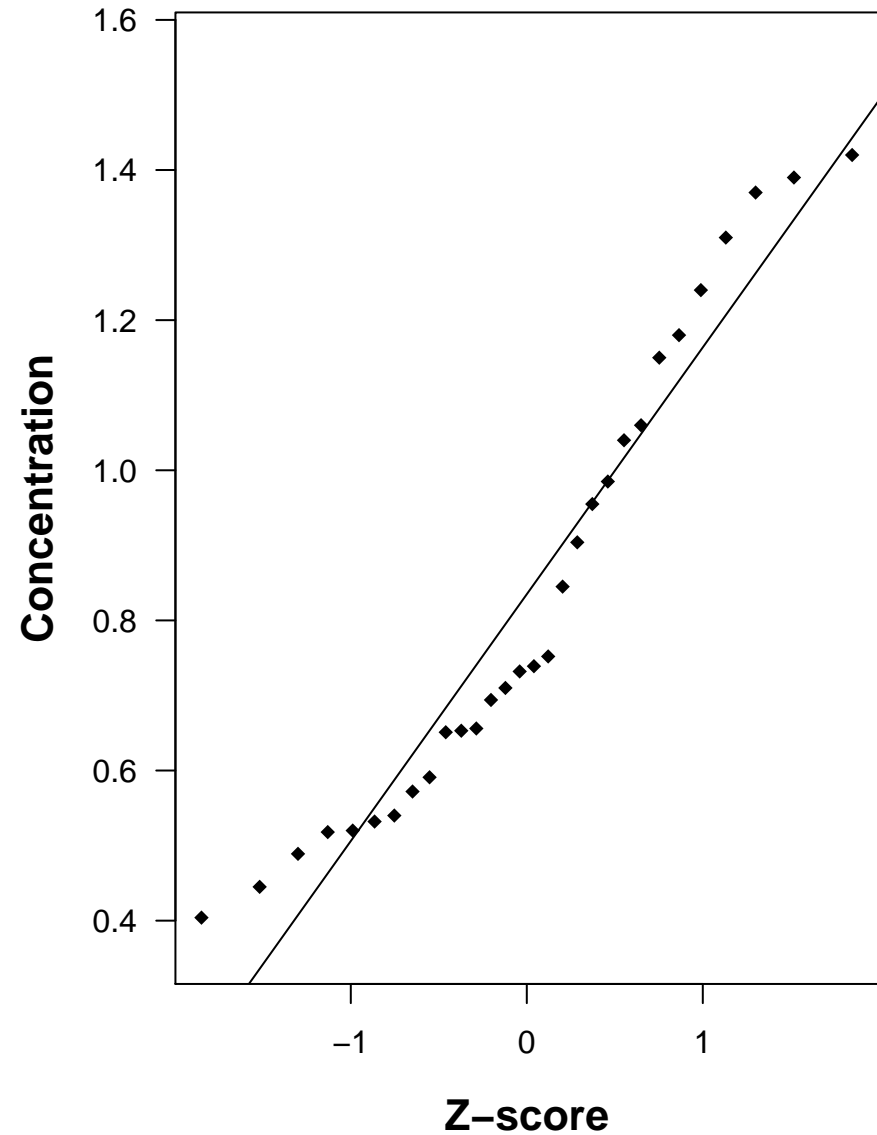
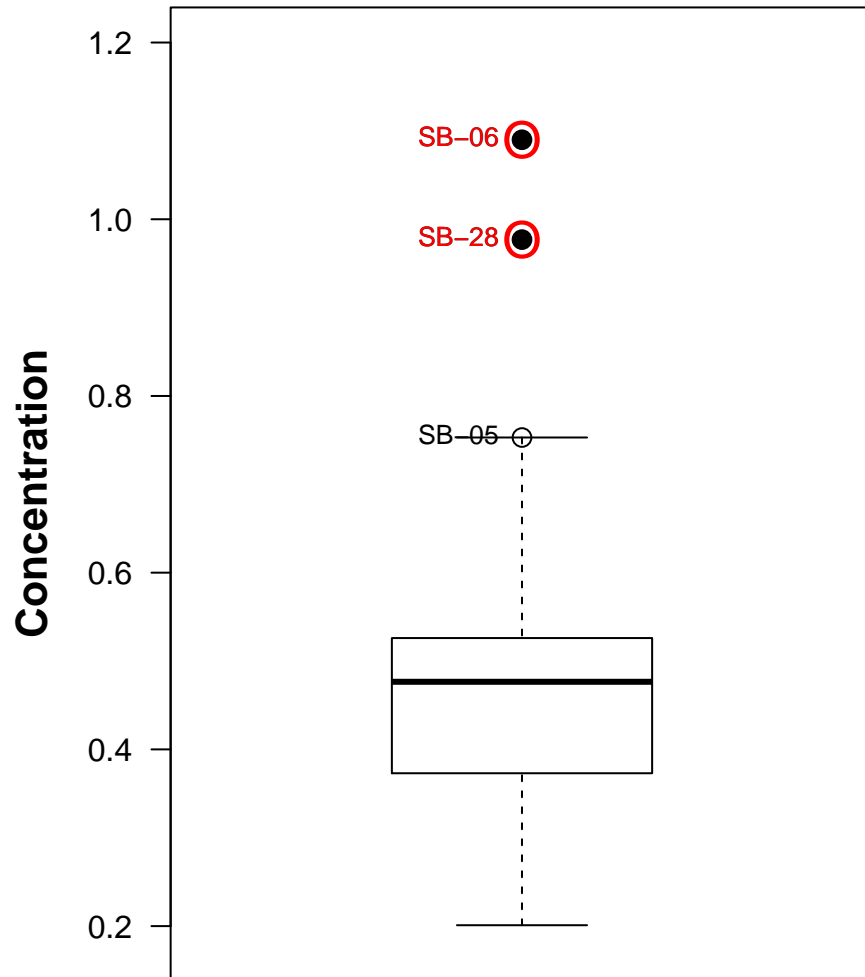


Figure B-9. SW6020, Beryllium (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=30/30, Gamma

Box Plot



Normal Probability Plot

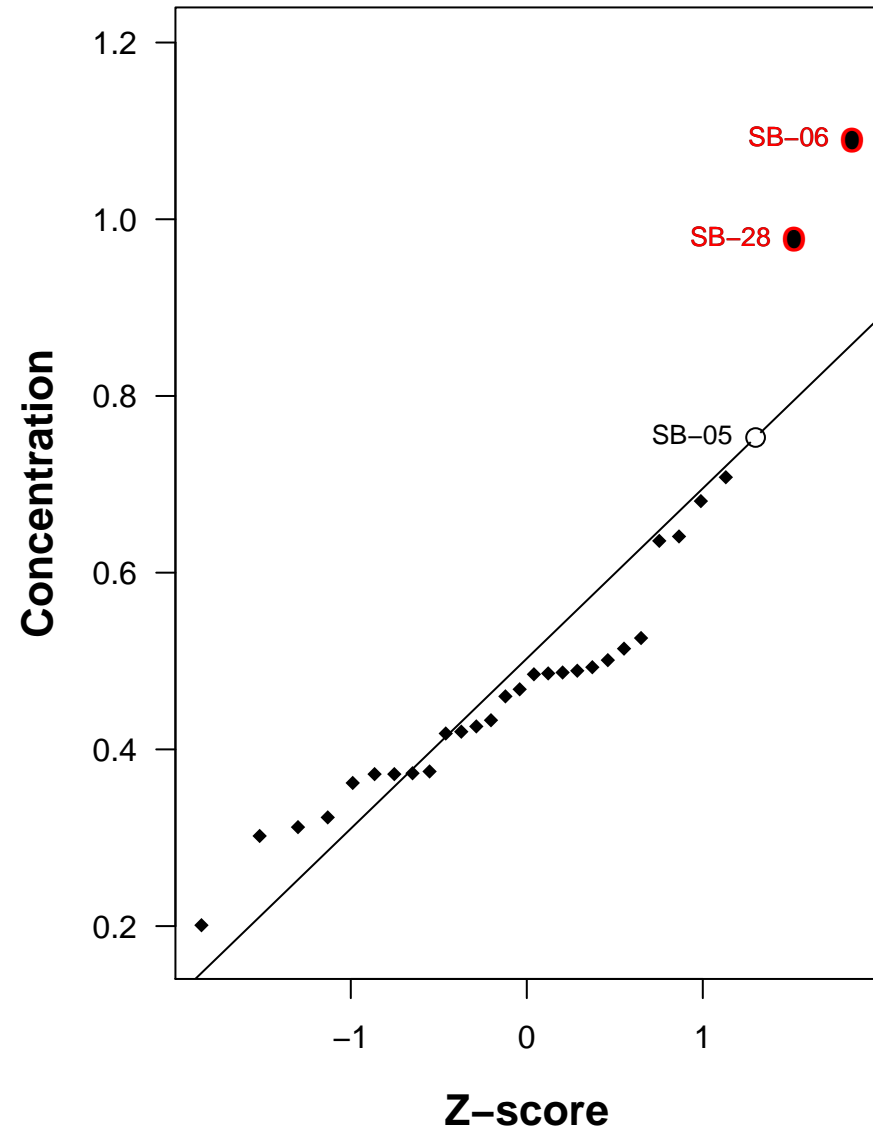
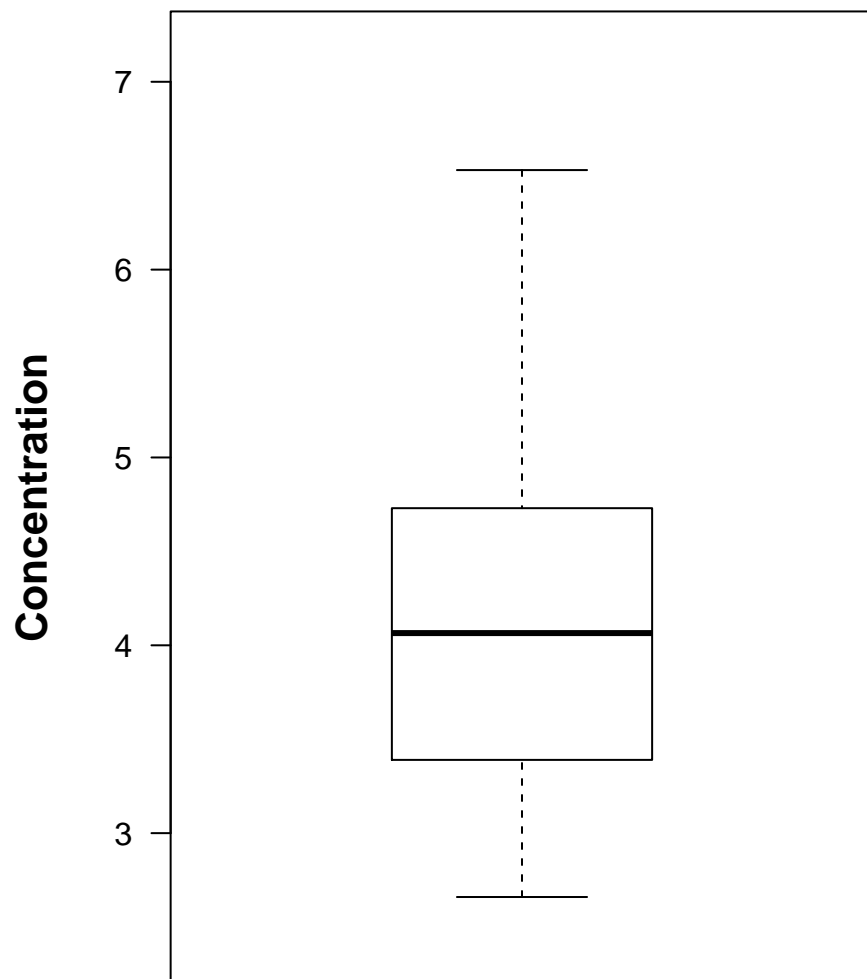


Figure B-10. SW6020, Boron (mg/Kg)

Shallow soil (1-2 feet) samples

Det/N=30/30, Normal

Box Plot



Normal Probability Plot

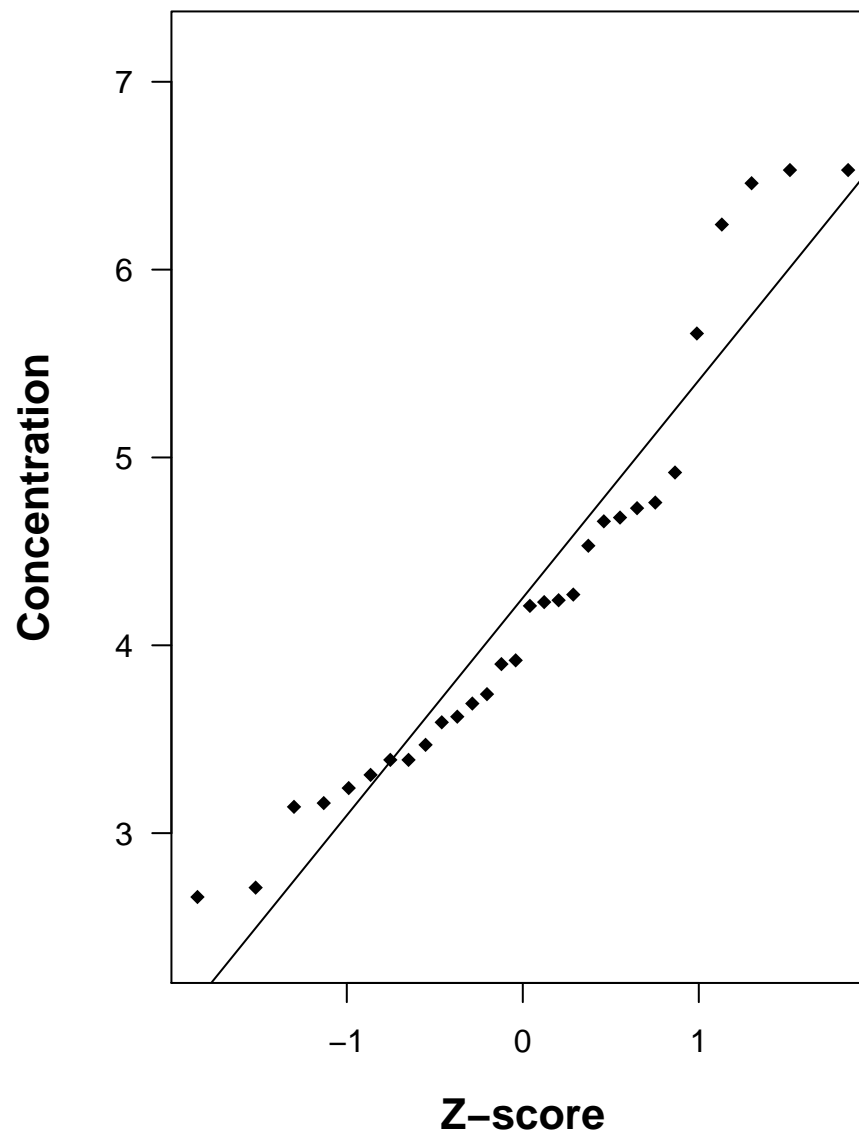
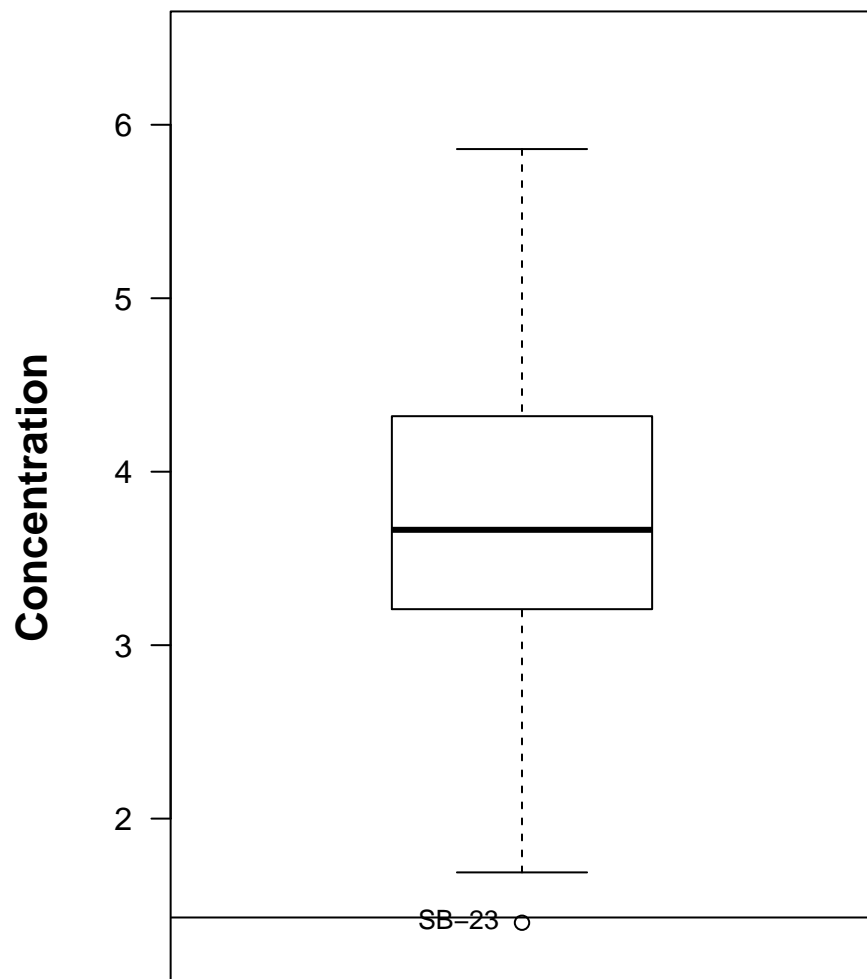


Figure B-11. SW6020, Boron (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=29/30, Normal

Box Plot



Normal Probability Plot

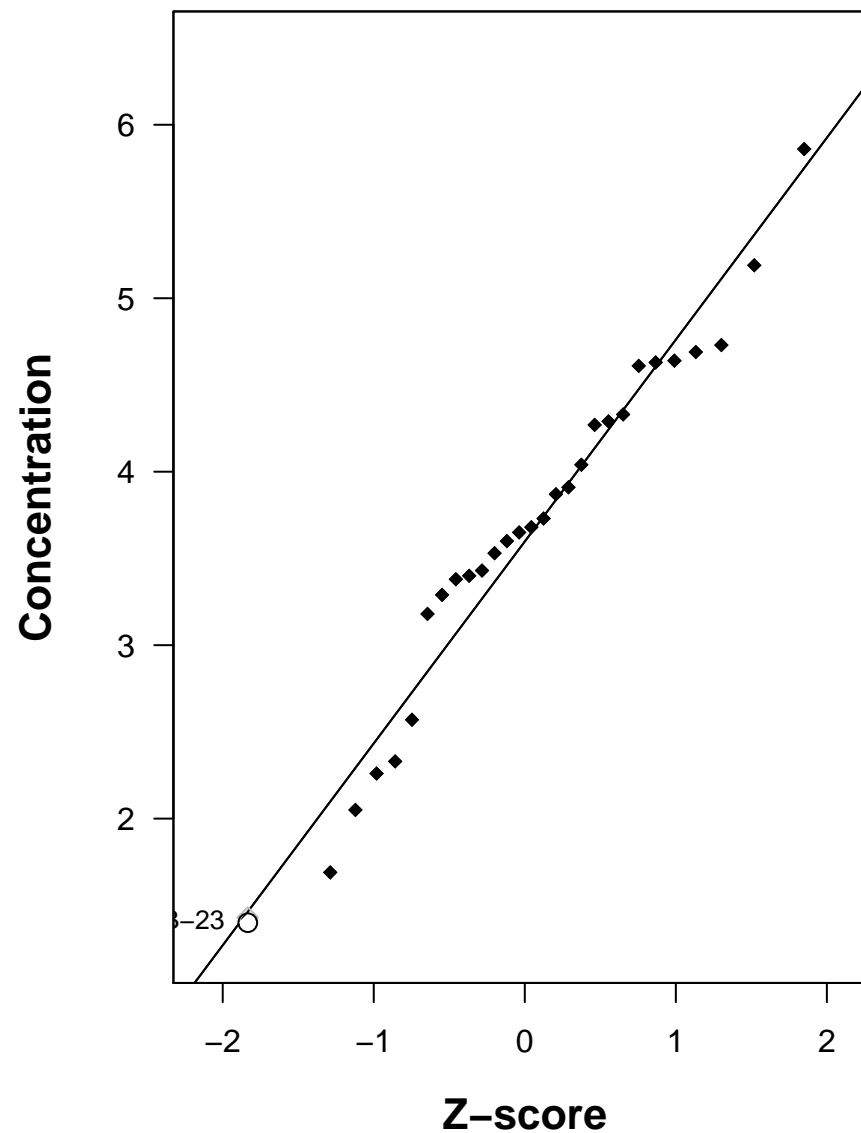
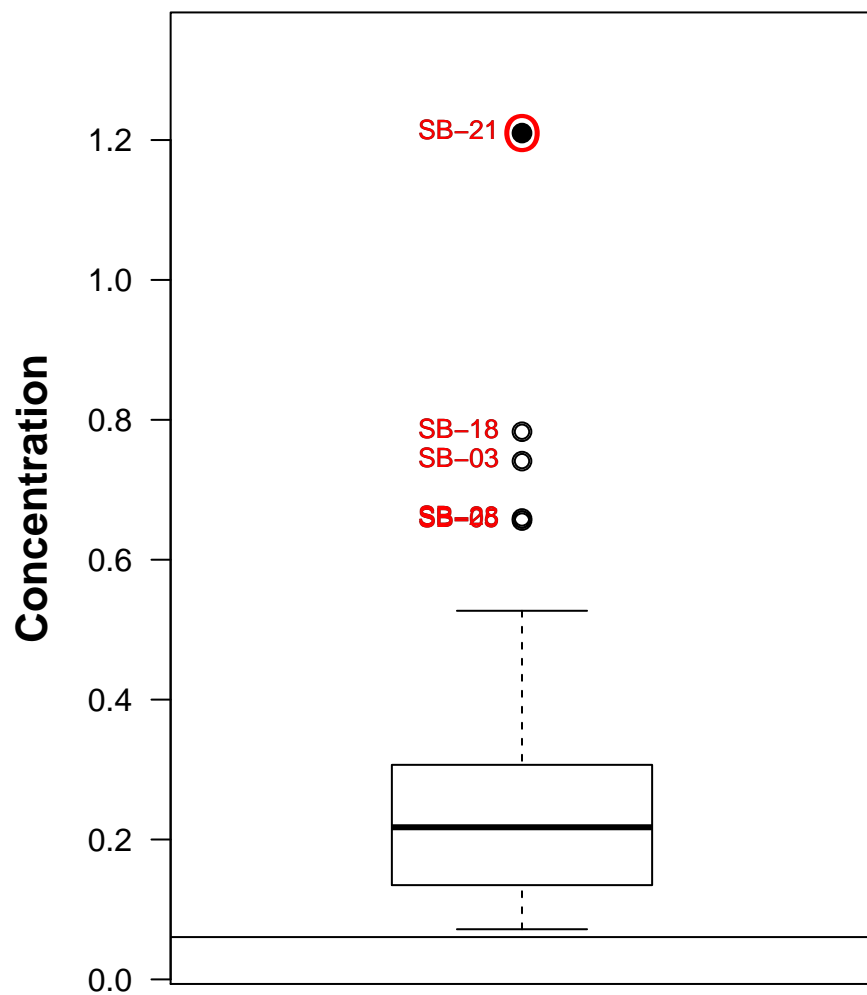


Figure B-12. SW6020, Cadmium (mg/Kg)

All samples
Det/N=51/60, Gamma

Box Plot



Normal Probability Plot

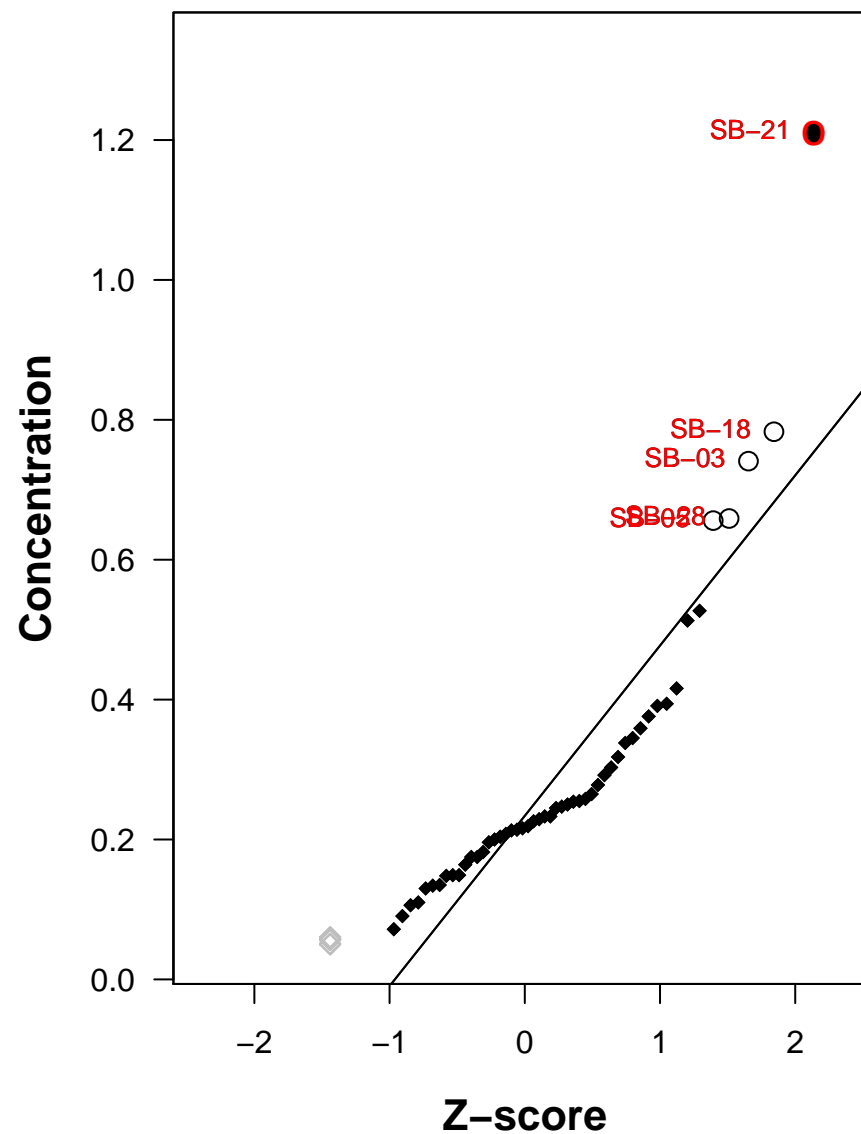
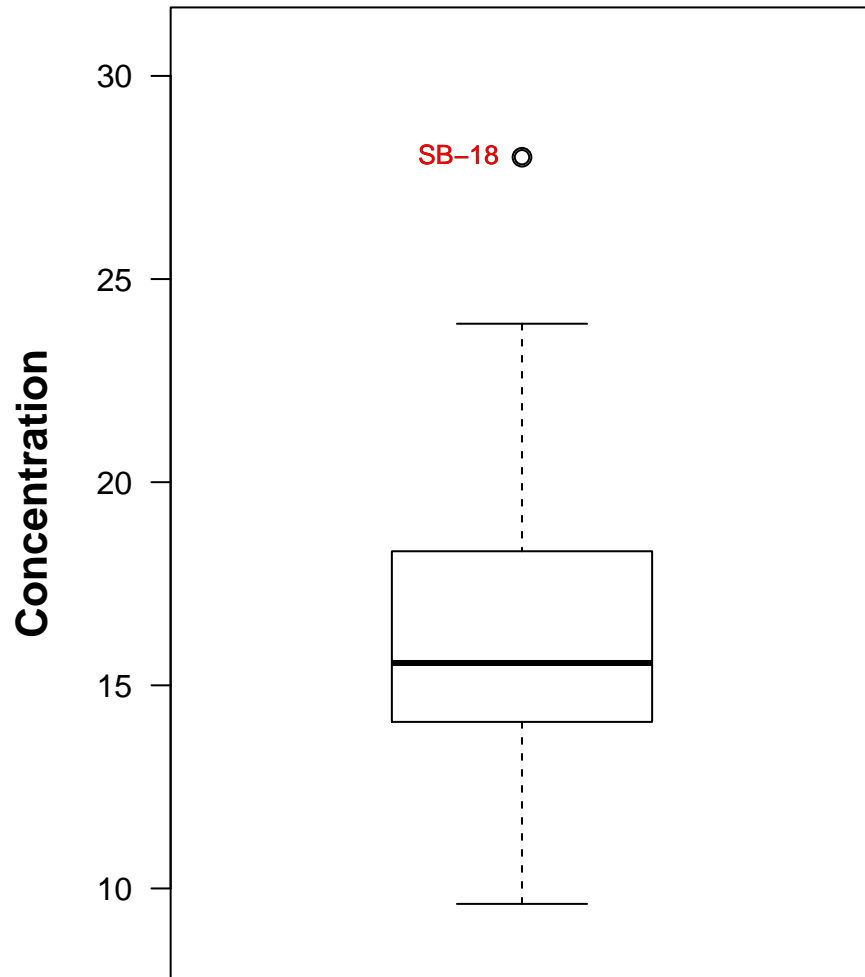


Figure B-13. SW6020, Chromium (mg/Kg)

Shallow soil (1-2 feet) samples

Det/N=30/30, Normal

Box Plot



Normal Probability Plot

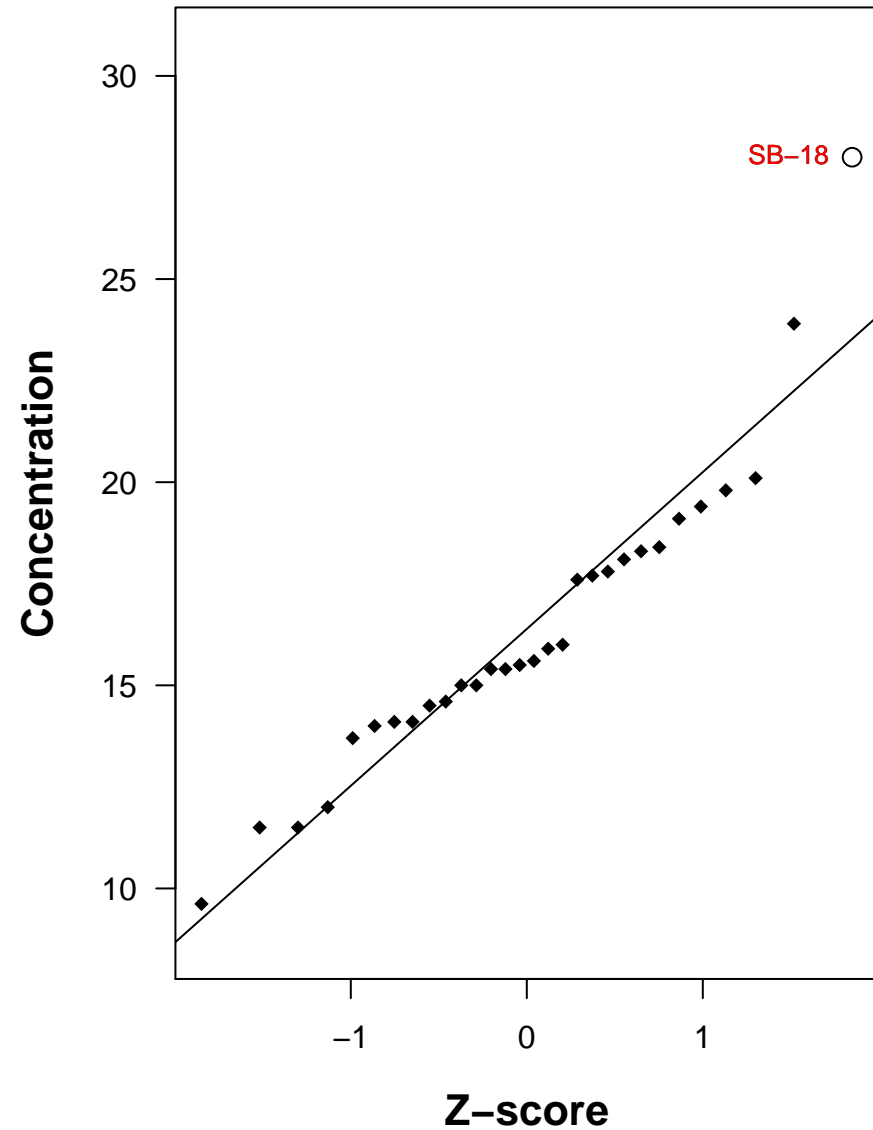
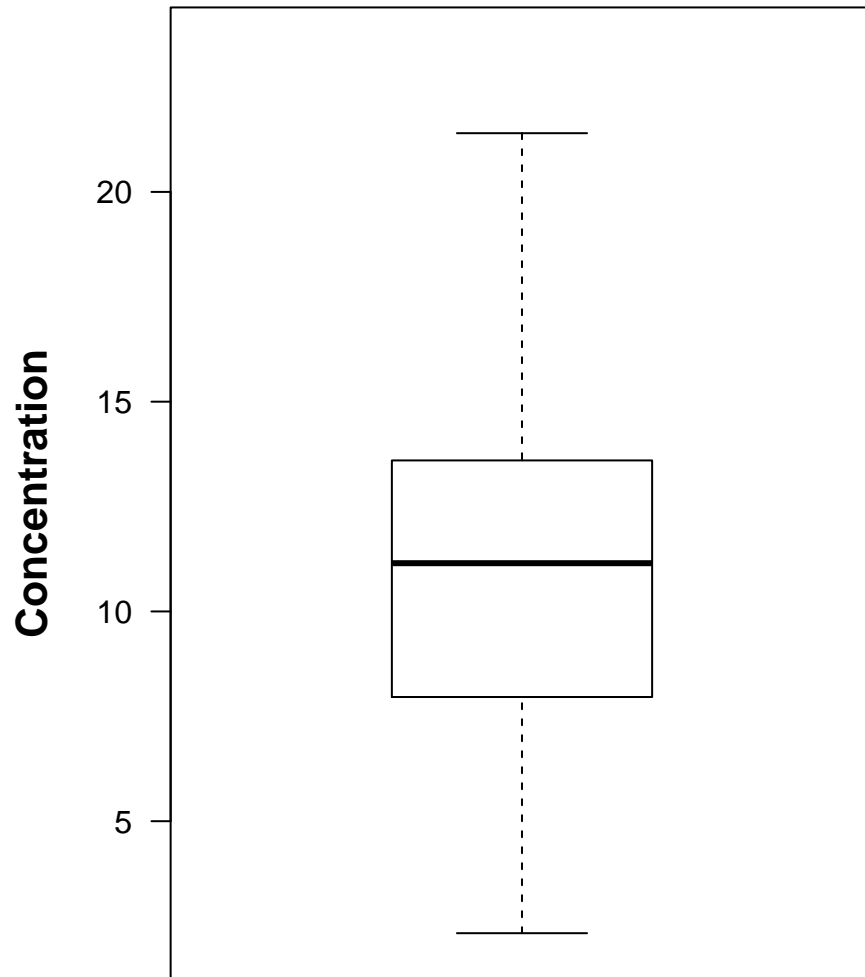


Figure B-14. SW6020, Chromium (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=30/30, Normal

Box Plot



Normal Probability Plot

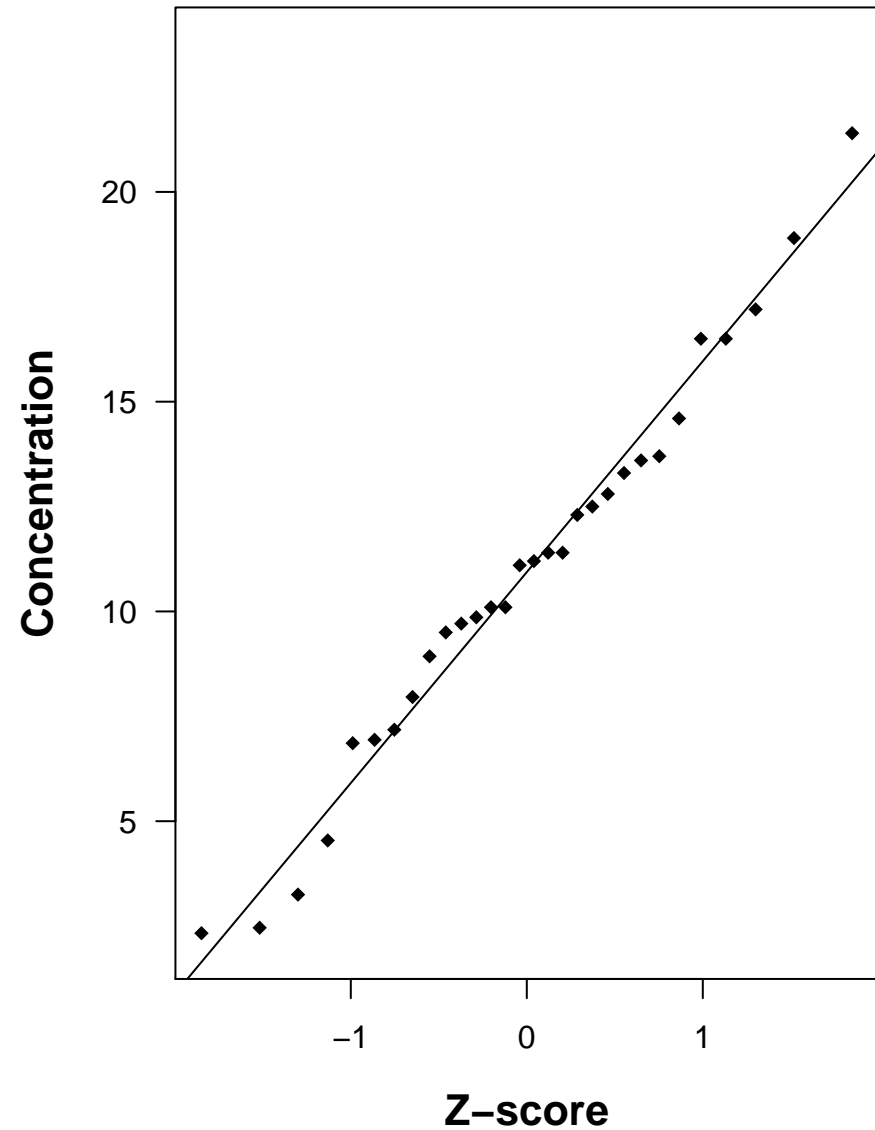
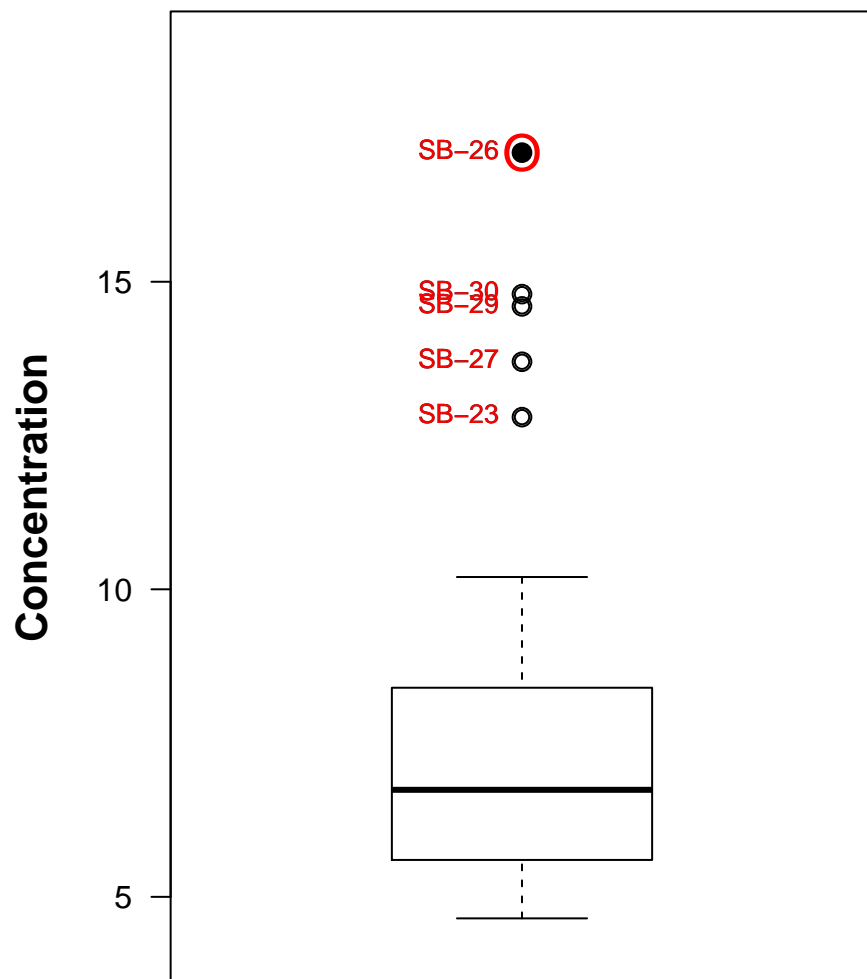


Figure B-15. SW6020, Cobalt (mg/Kg)

Shallow soil (1-2 feet) samples

Det/N=30/30, Gamma

Box Plot



Normal Probability Plot

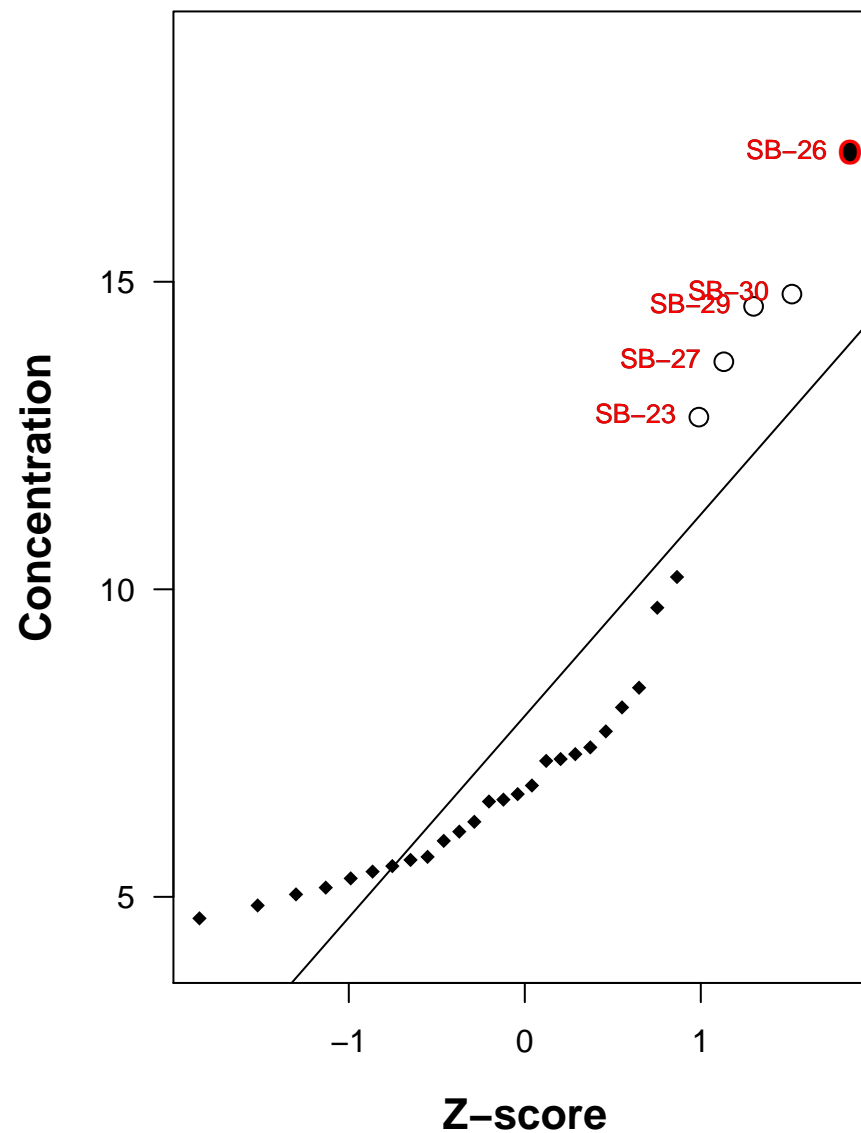
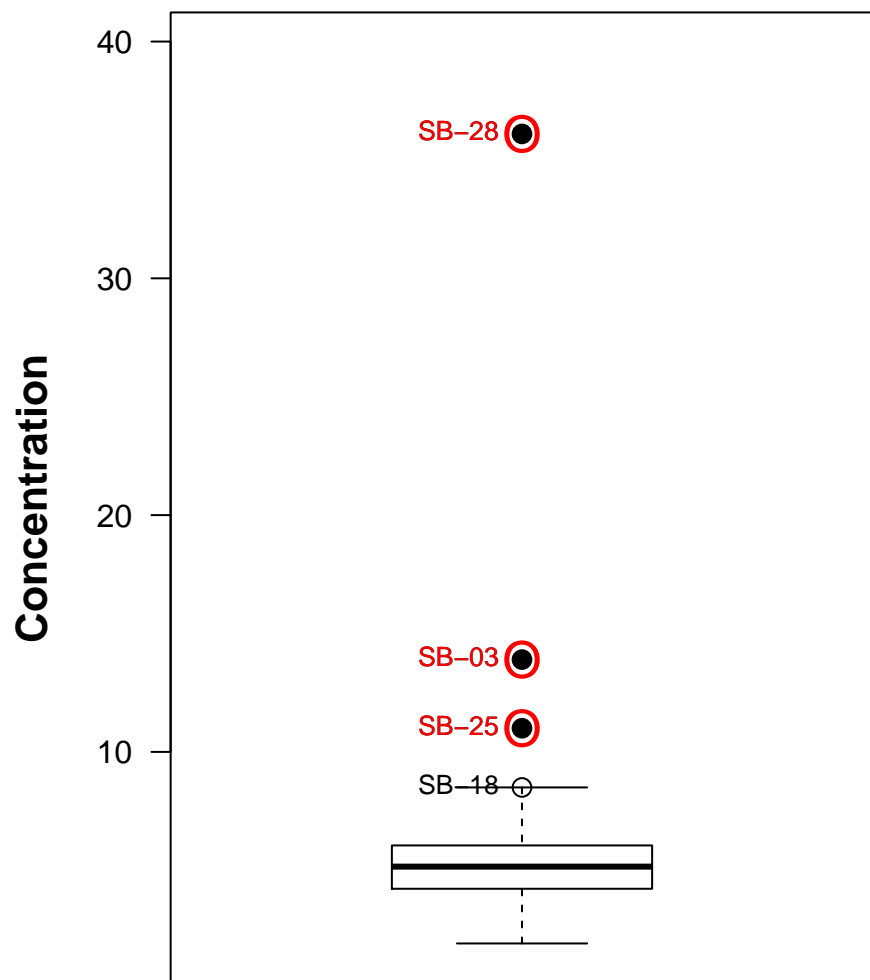


Figure B-16. SW6020, Cobalt (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=30/30, Nonparametric

Box Plot



Normal Probability Plot

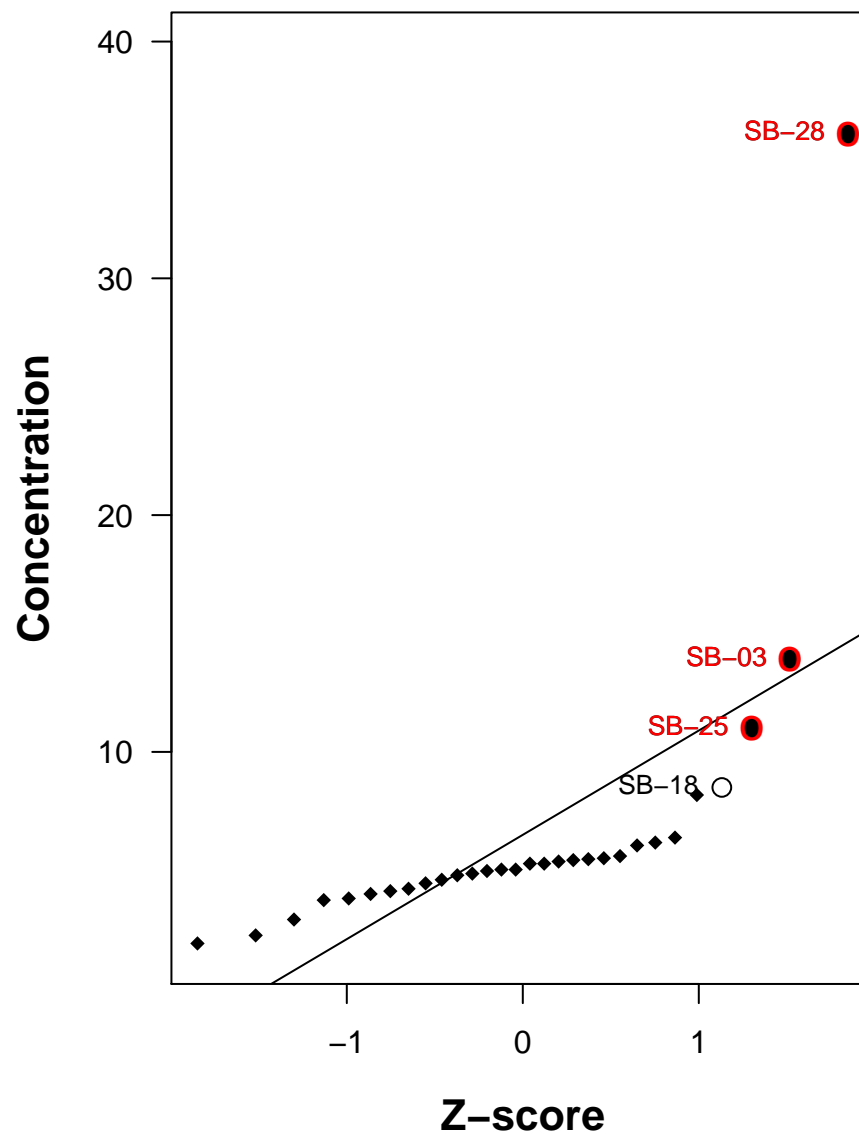
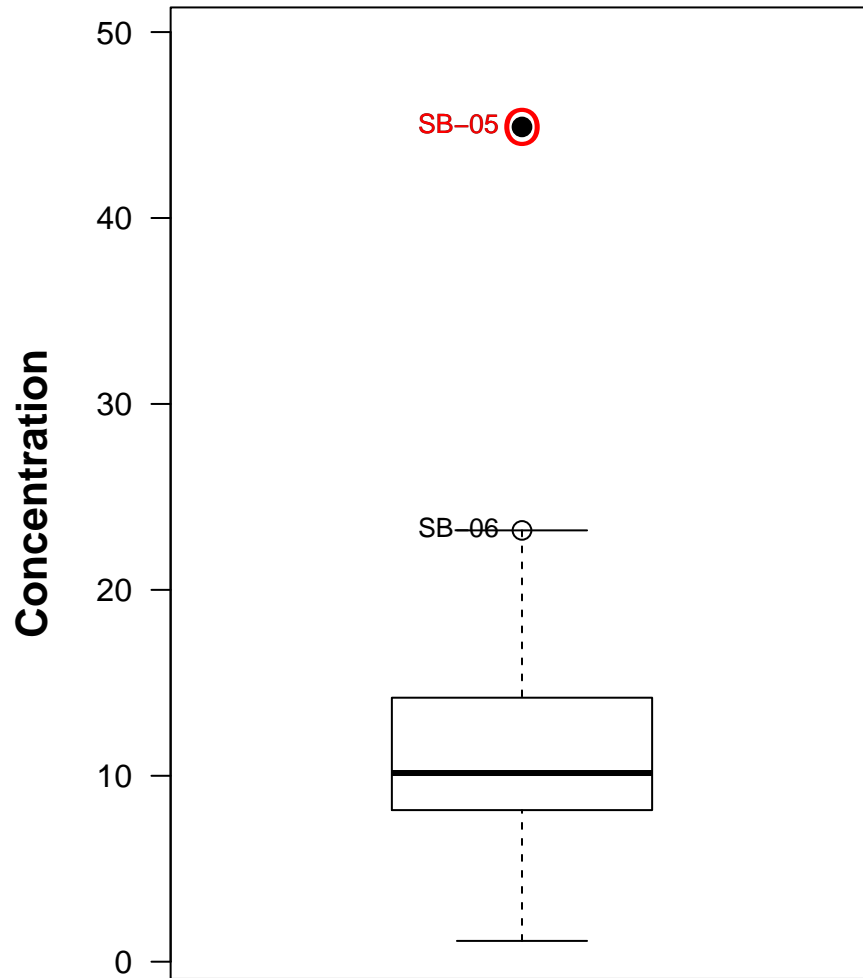


Figure B-17. SW6020, Copper (mg/Kg)

No Tidal Influence samples

Det/N=40/40, Gamma

Box Plot



Normal Probability Plot

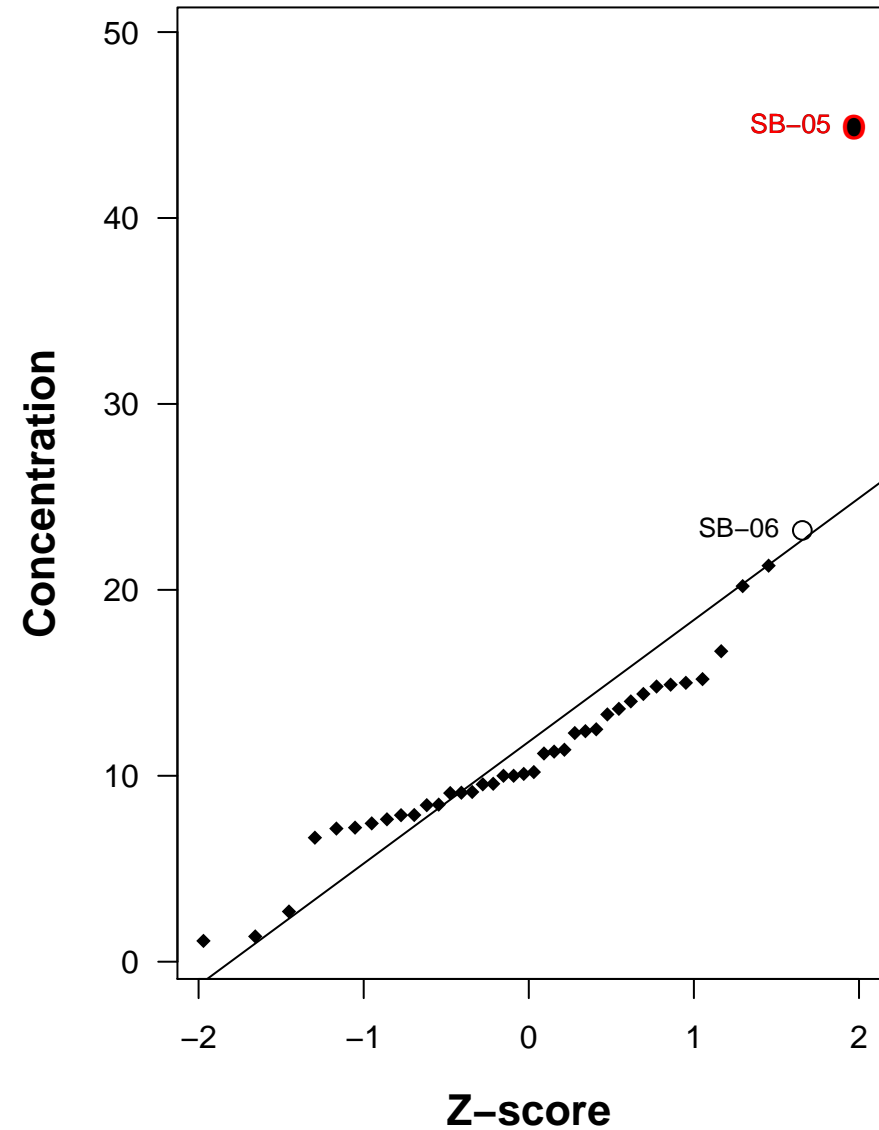
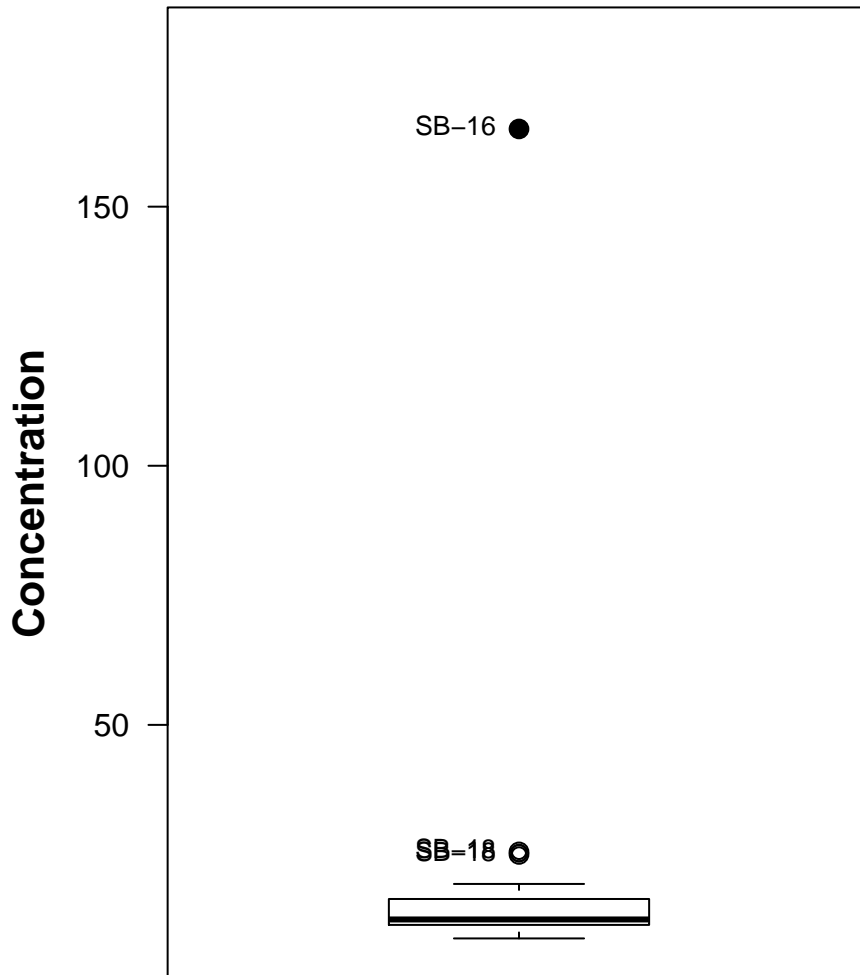


Figure B-18. SW6020, Copper (mg/Kg)

Tidal Influence samples
Det/N=20/20, Gamma

Box Plot



Normal Probability Plot

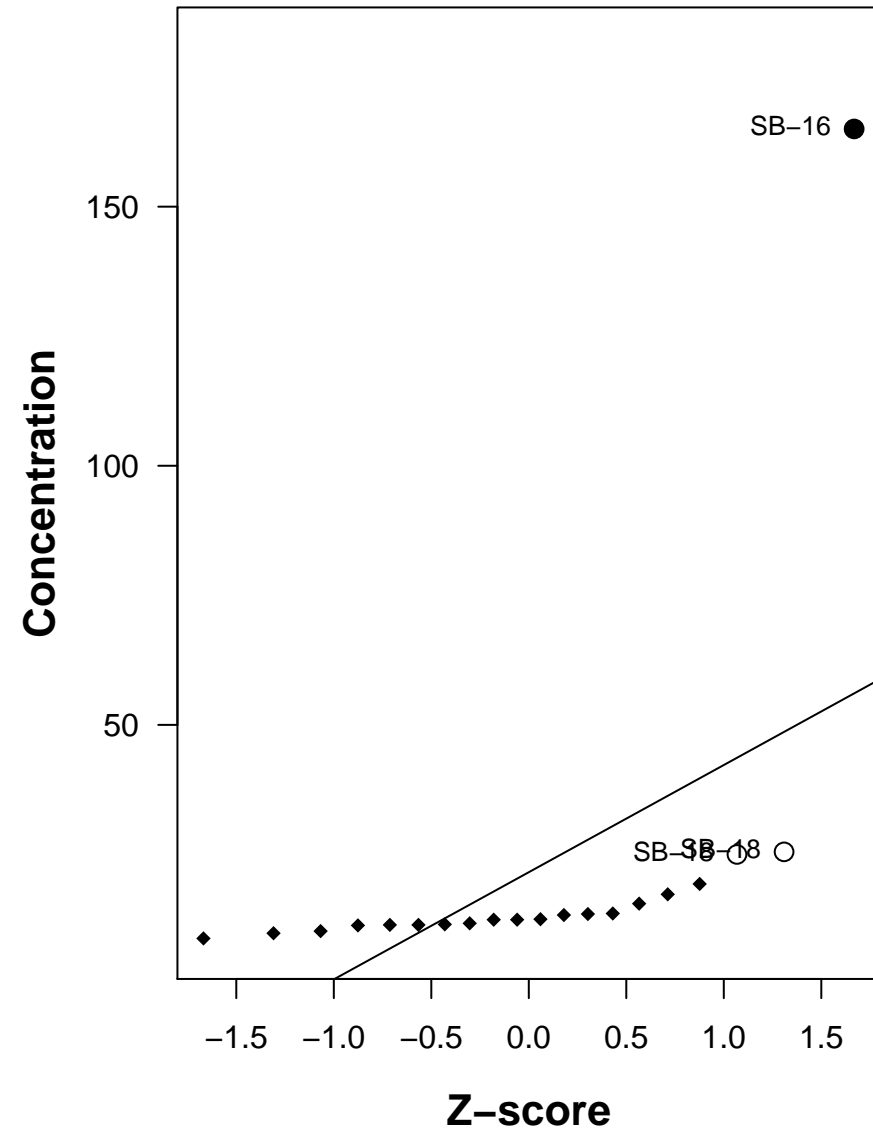
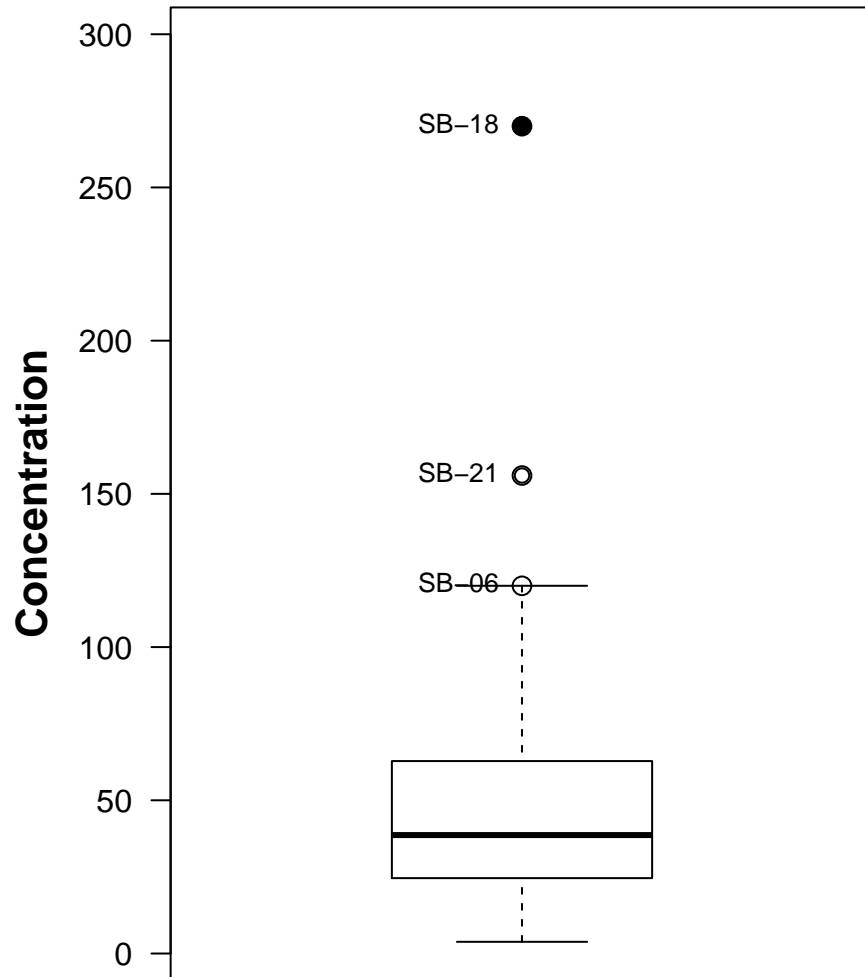


Figure B-19. SW6020, Lead (mg/Kg)

All samples
Det/N=60/60, Gamma

Box Plot



Normal Probability Plot

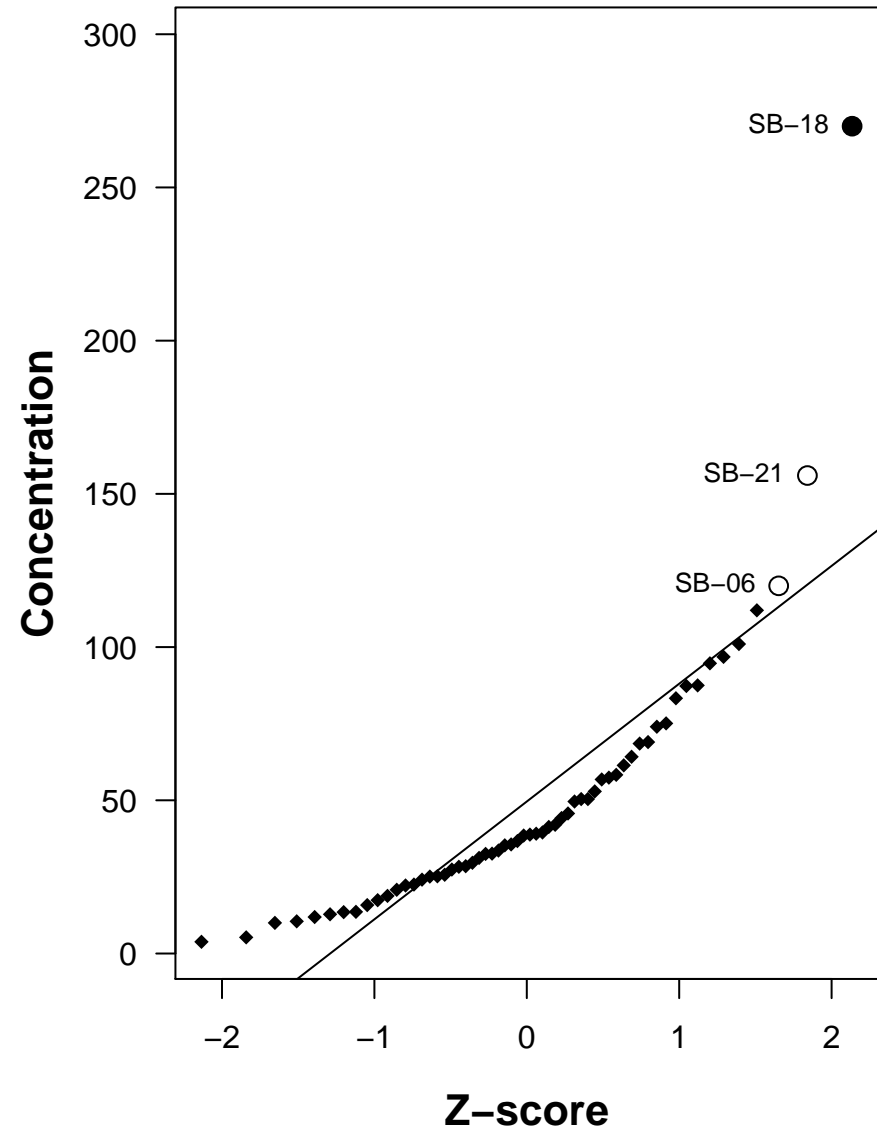
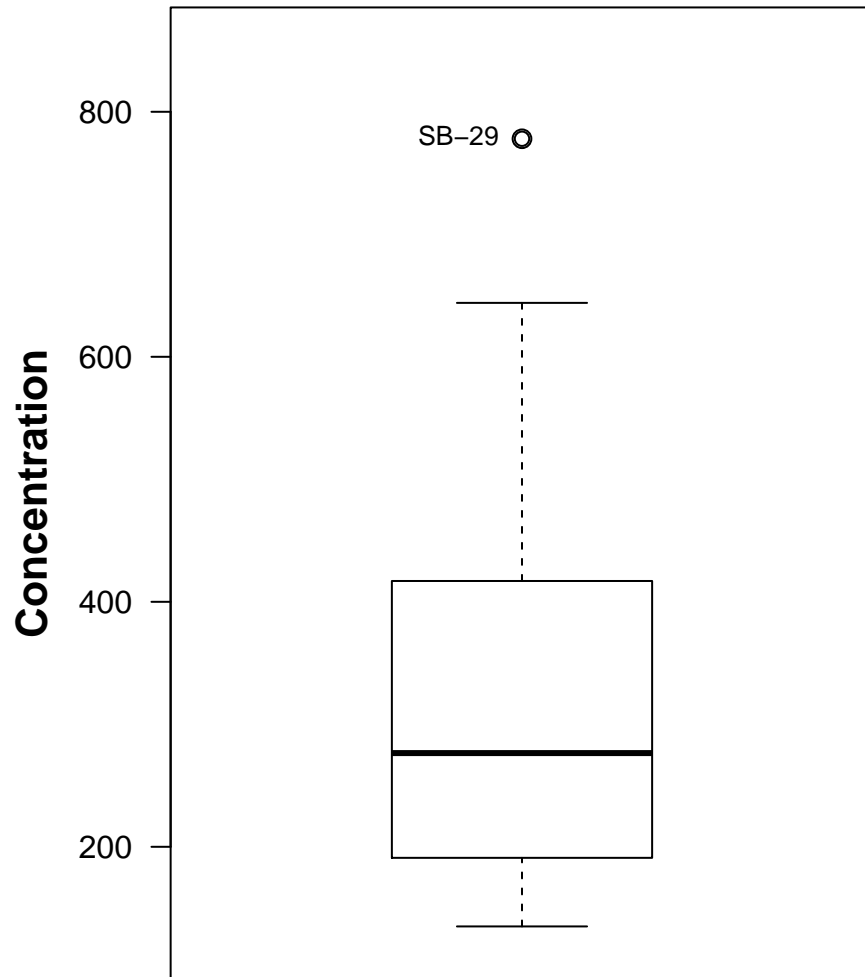


Figure B-20. SW6020, Manganese (mg/Kg)

Shallow soil (1-2 feet) samples

Det/N=30/30, Gamma

Box Plot



Normal Probability Plot

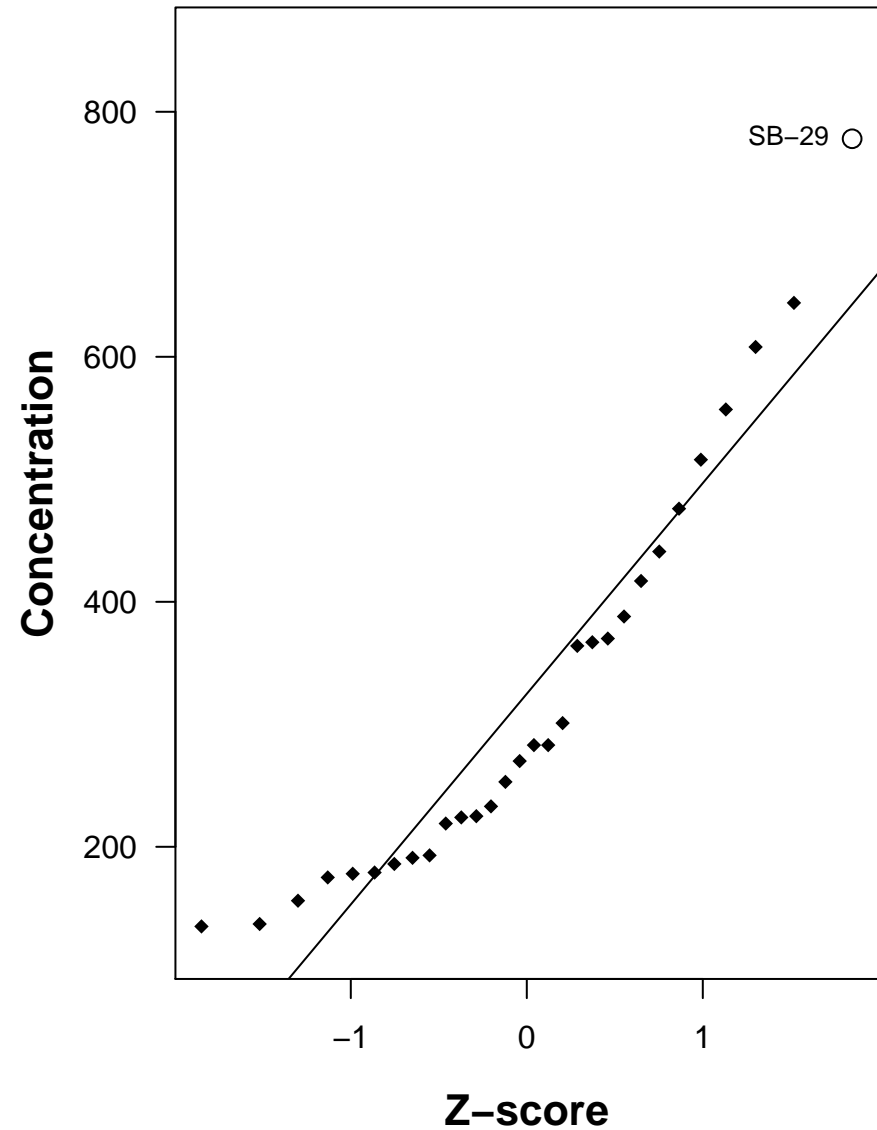
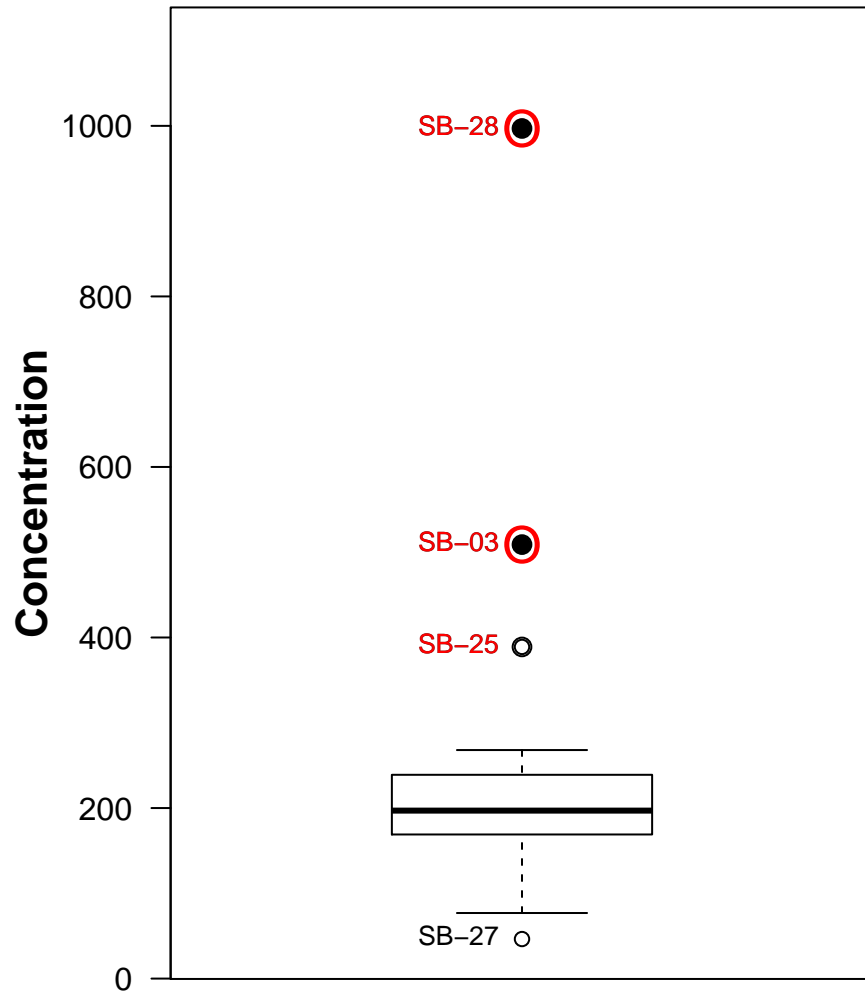


Figure B-21. SW6020, Manganese (mg/Kg)

Surface soil (0–0.5 feet) samples

Det/N=30/30, Gamma

Box Plot



Normal Probability Plot

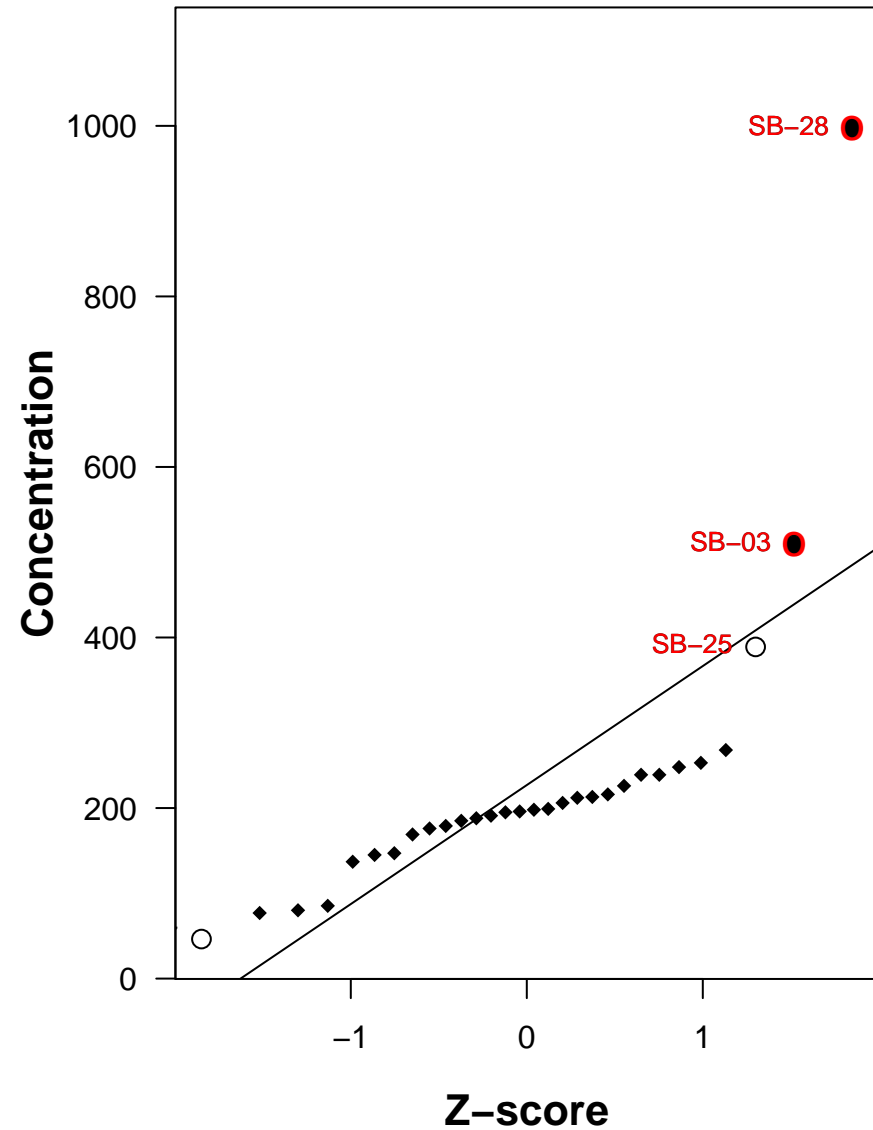
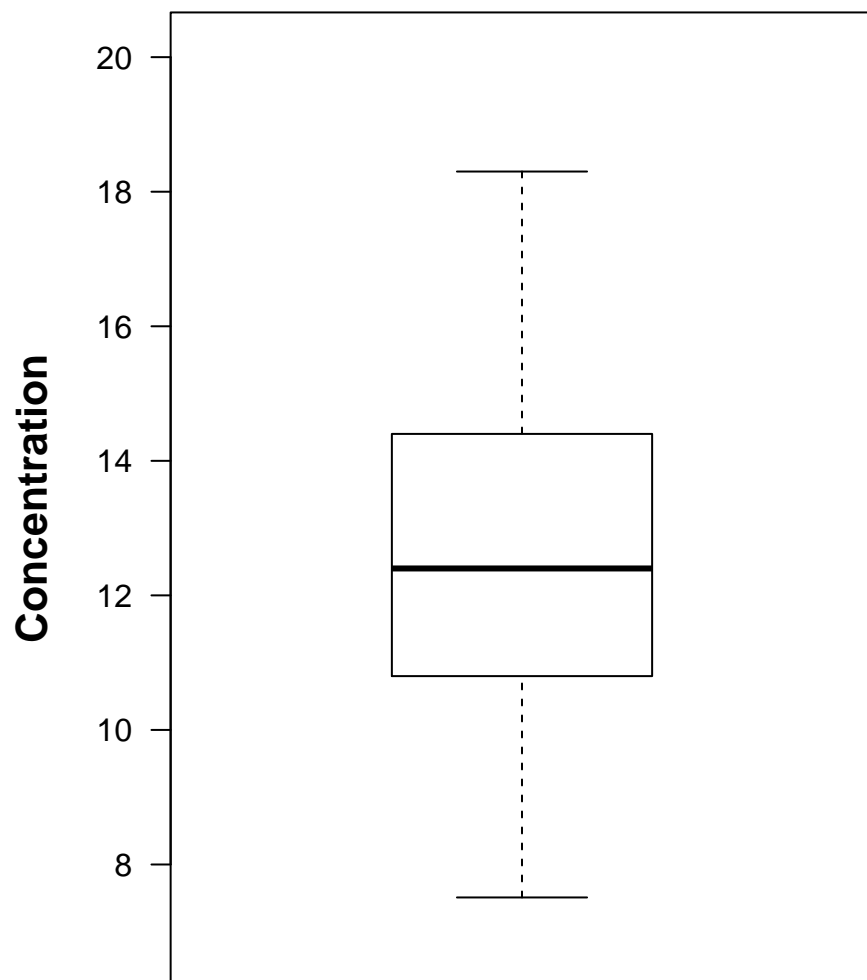


Figure B-22. SW6020, Nickel (mg/Kg)

Shallow soil (1-2 feet) samples

Det/N=30/30, Normal

Box Plot



Normal Probability Plot

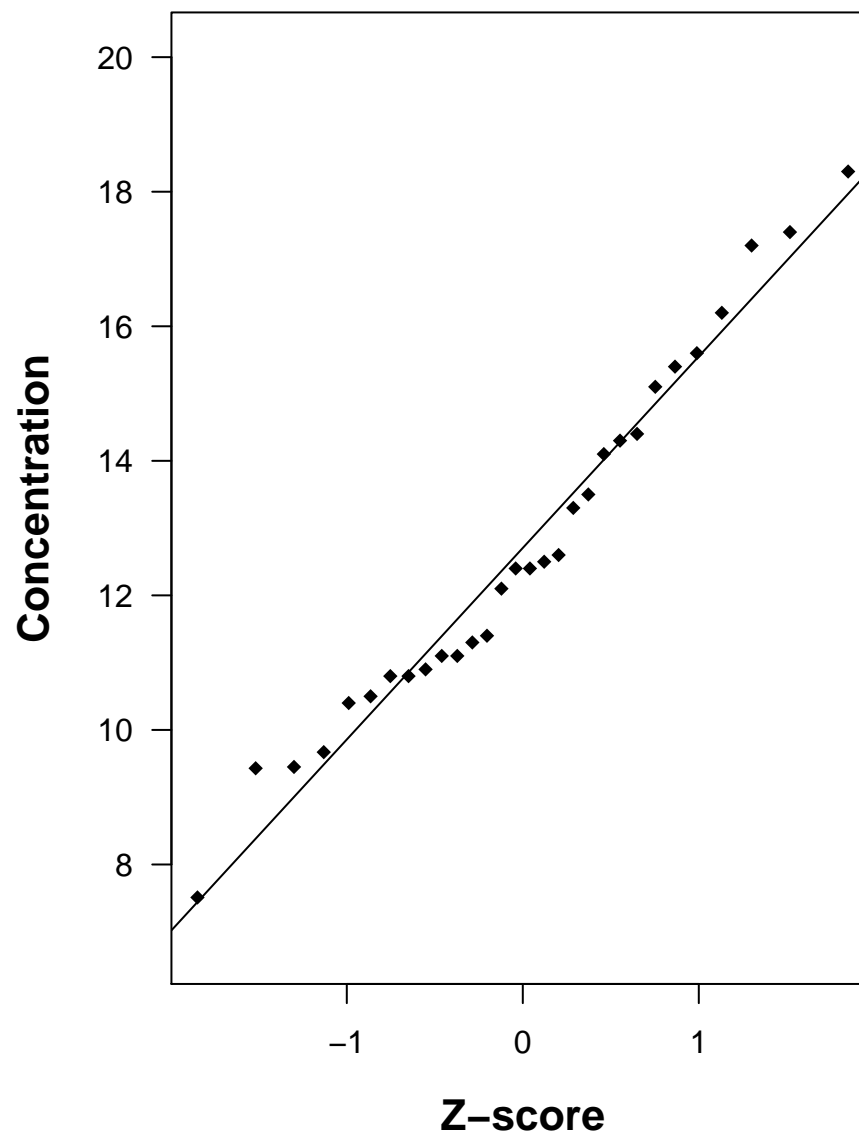
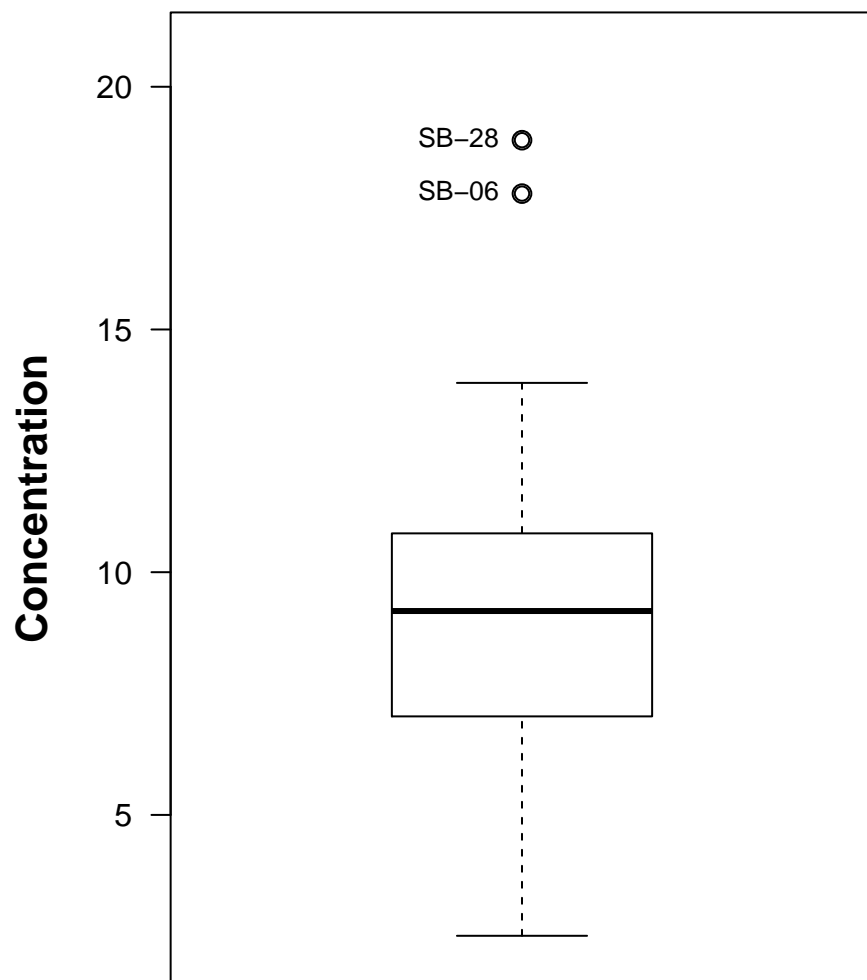


Figure B-23. SW6020, Nickel (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=30/30, Normal

Box Plot



Normal Probability Plot

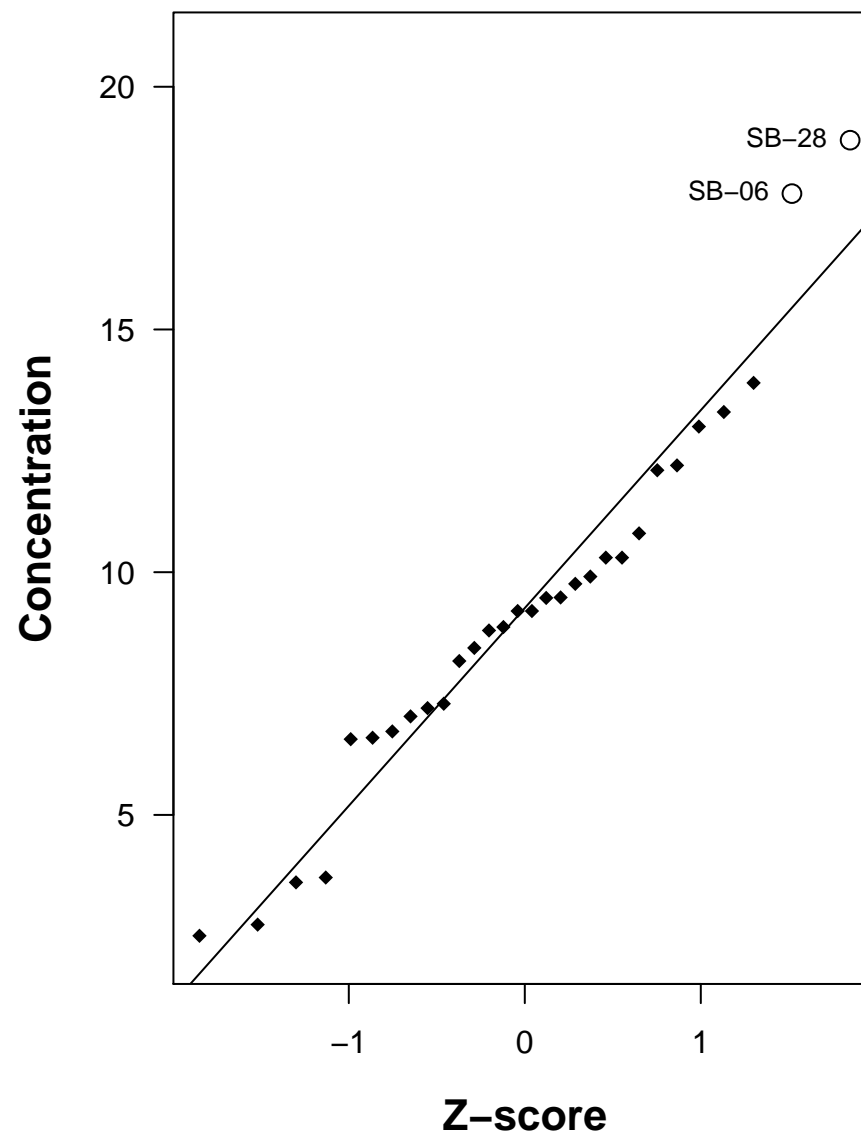
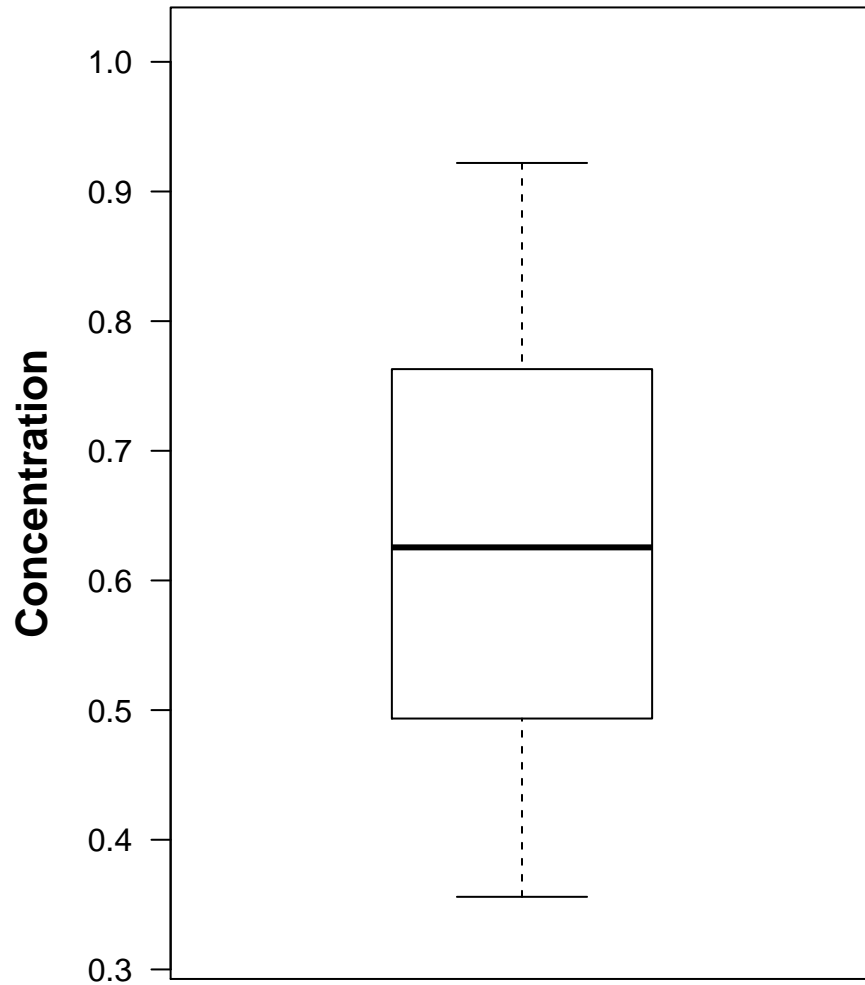


Figure B-24. SW6020, Selenium (mg/Kg)

No Tidal Influence Shallow soil (1-2 feet) samples

Det/N=20/20, Normal

Box Plot



Normal Probability Plot

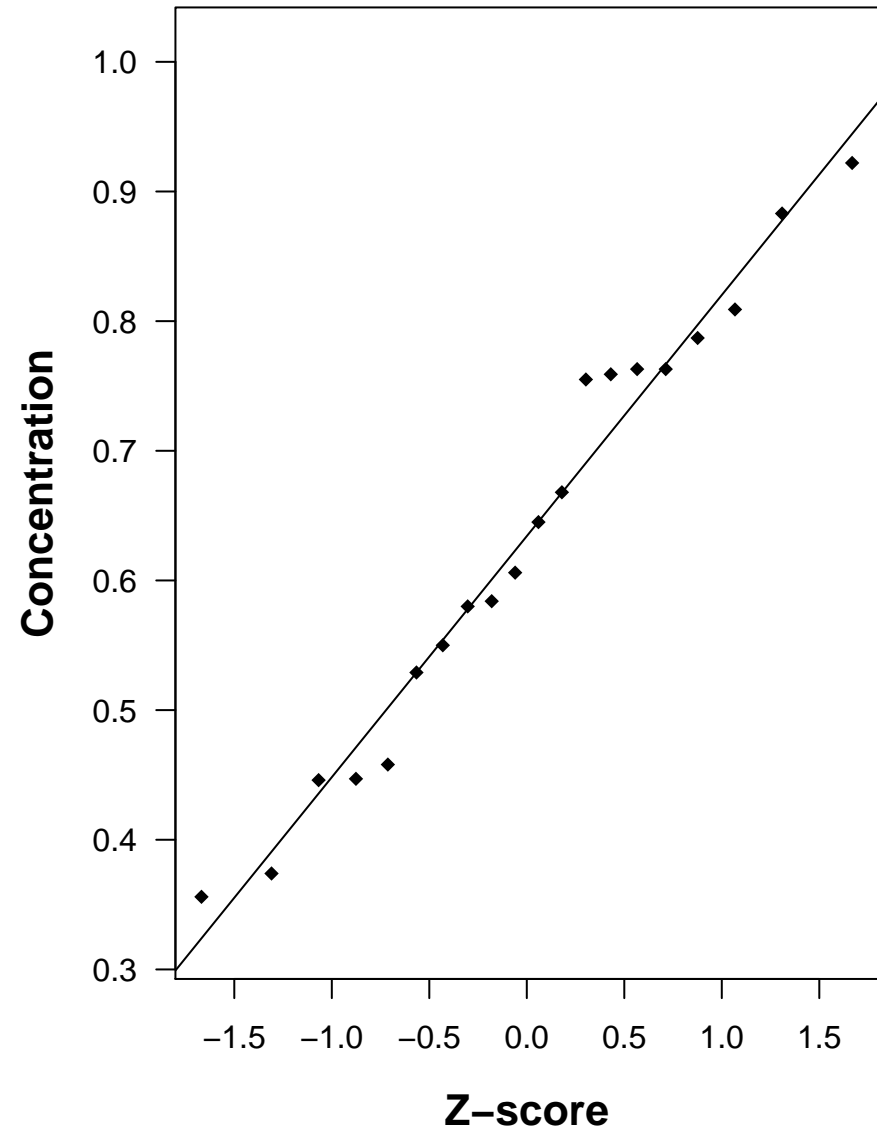
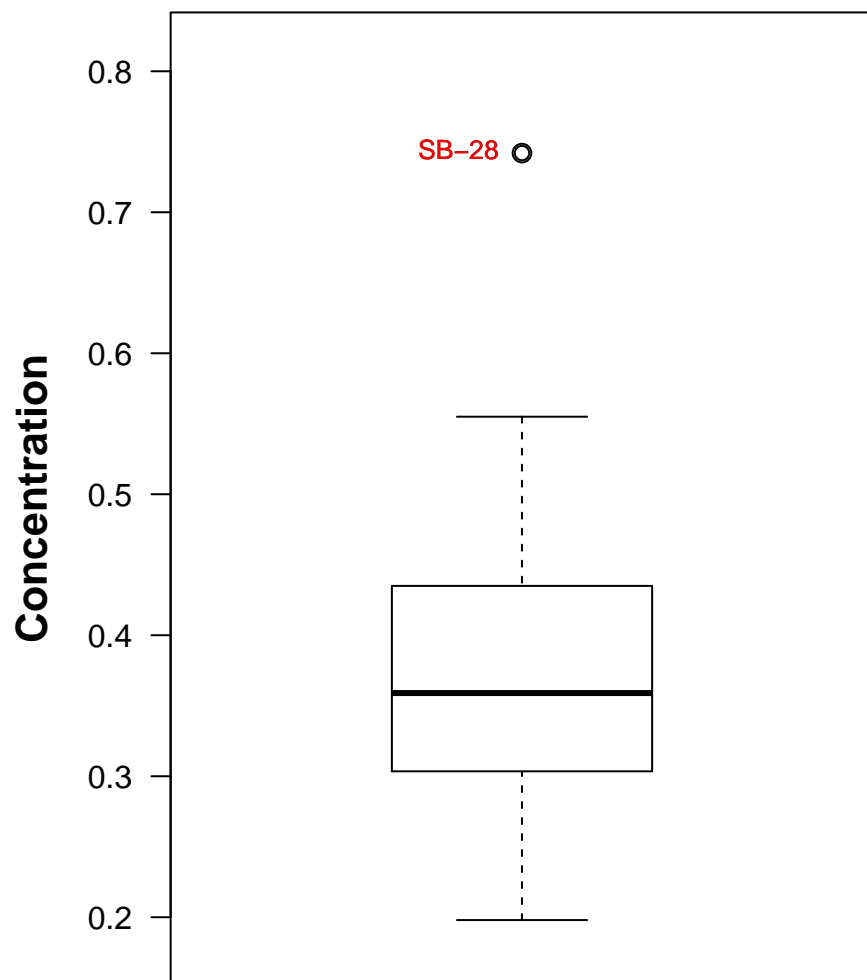


Figure B-25. SW6020, Selenium (mg/Kg)

No Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=20/20, Normal

Box Plot



Normal Probability Plot

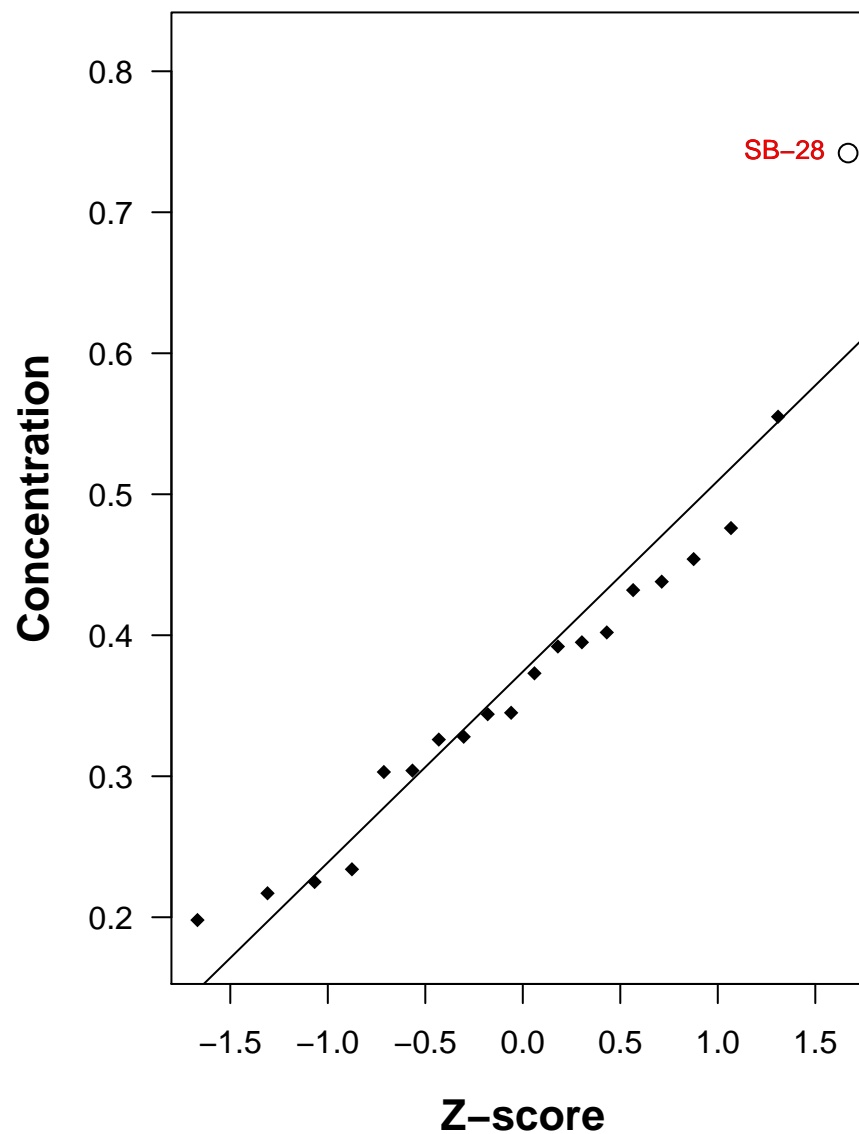
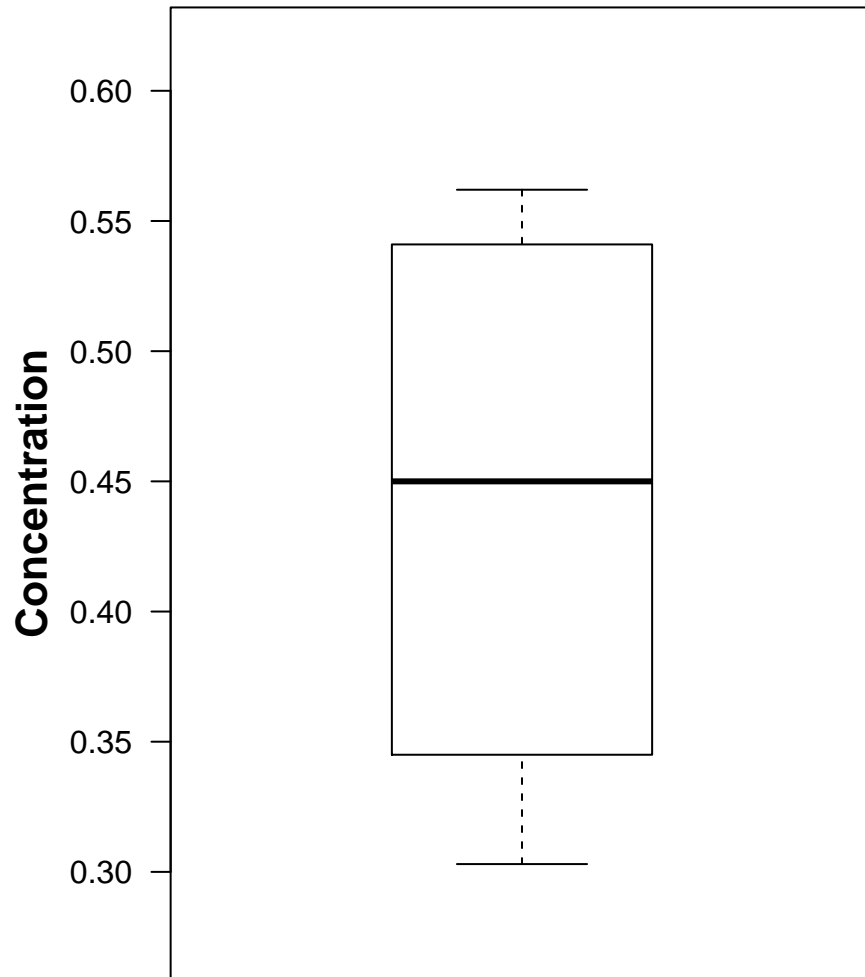


Figure B-26. SW6020, Selenium (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

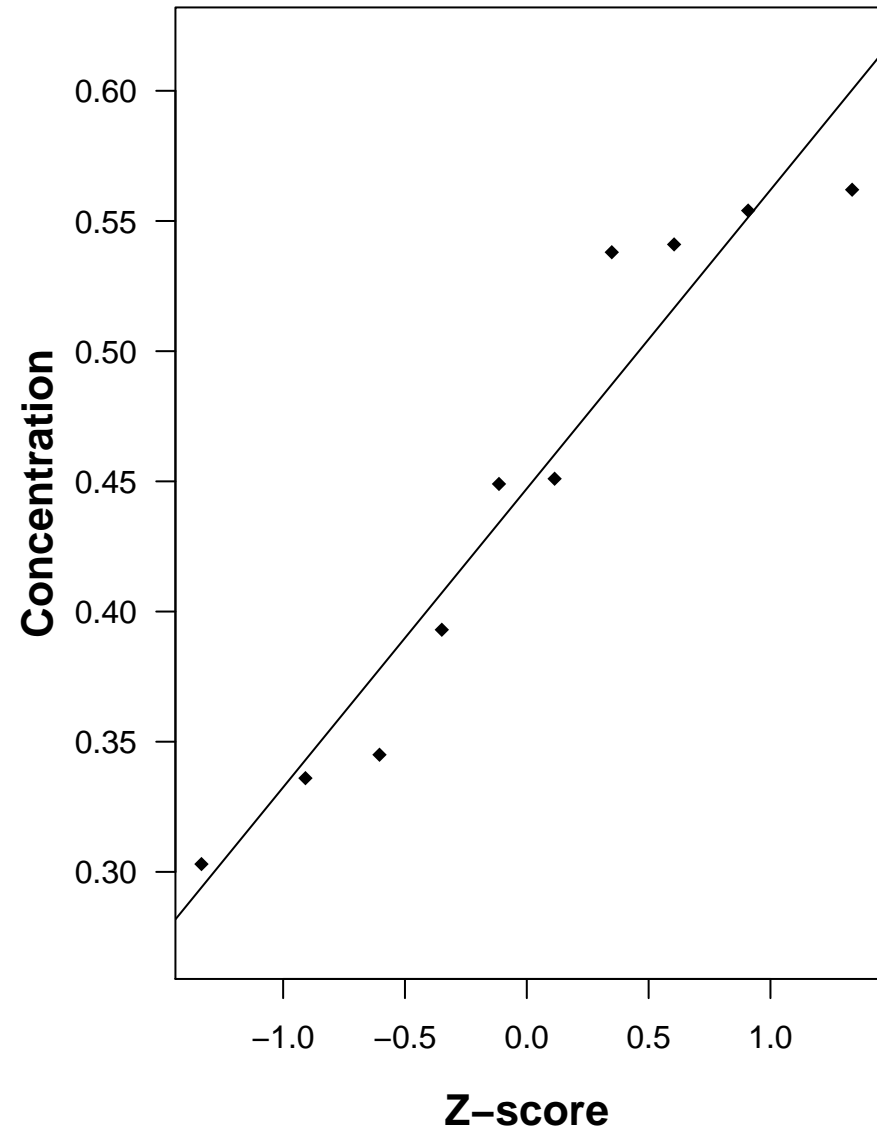
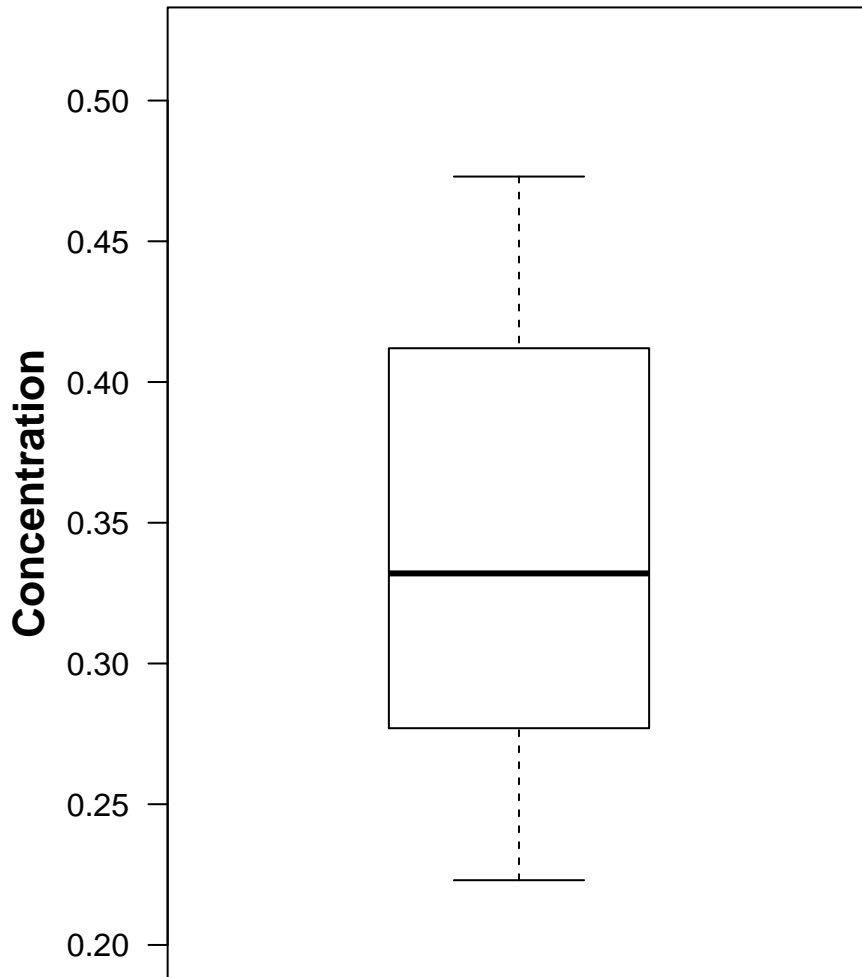


Figure B-27. SW6020, Selenium (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

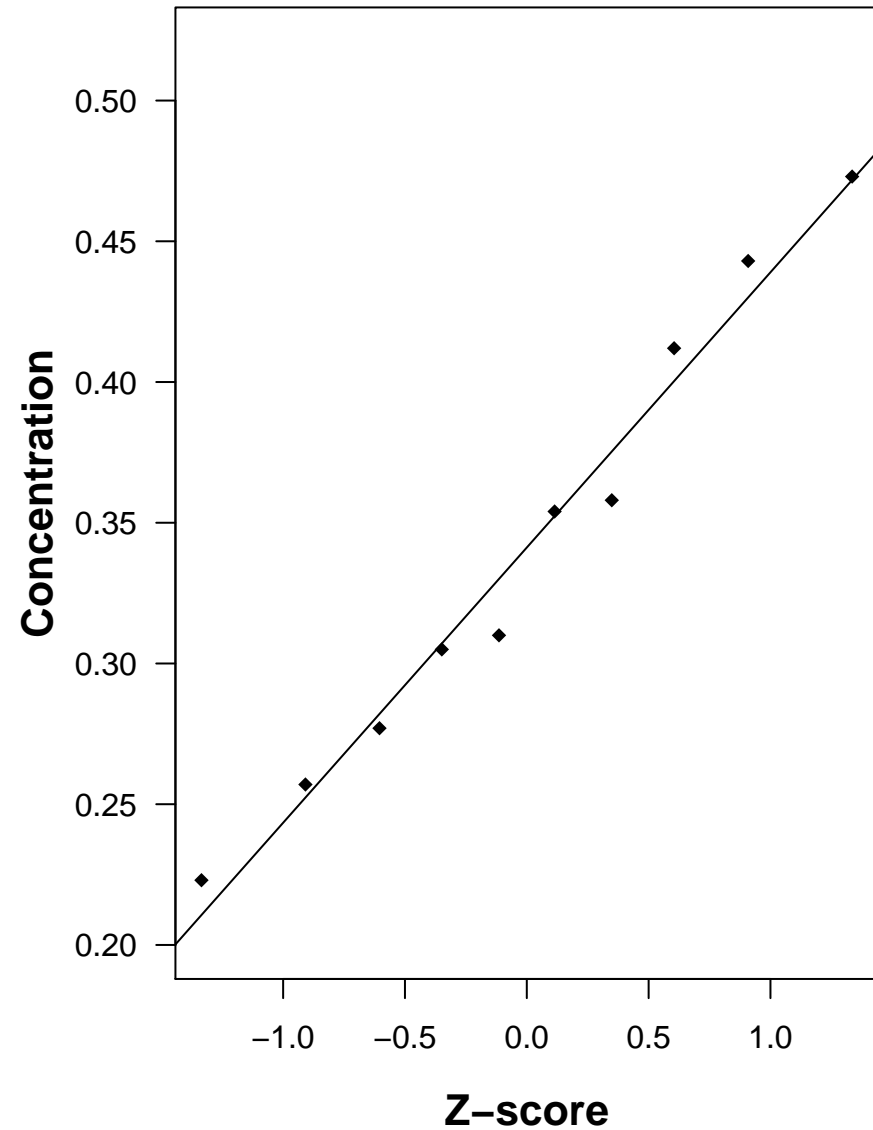
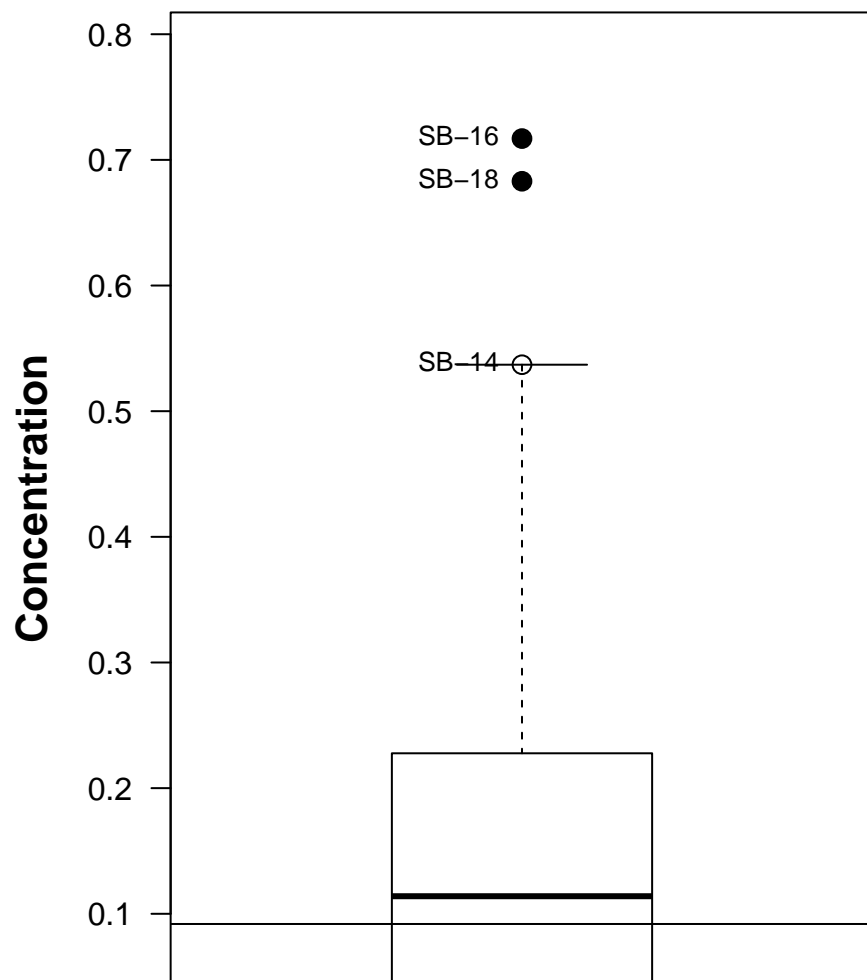


Figure B-28. SW6020, Silver (mg/Kg)

Tidal Influence samples
Det/N=13/20, Normal

Box Plot



Normal Probability Plot

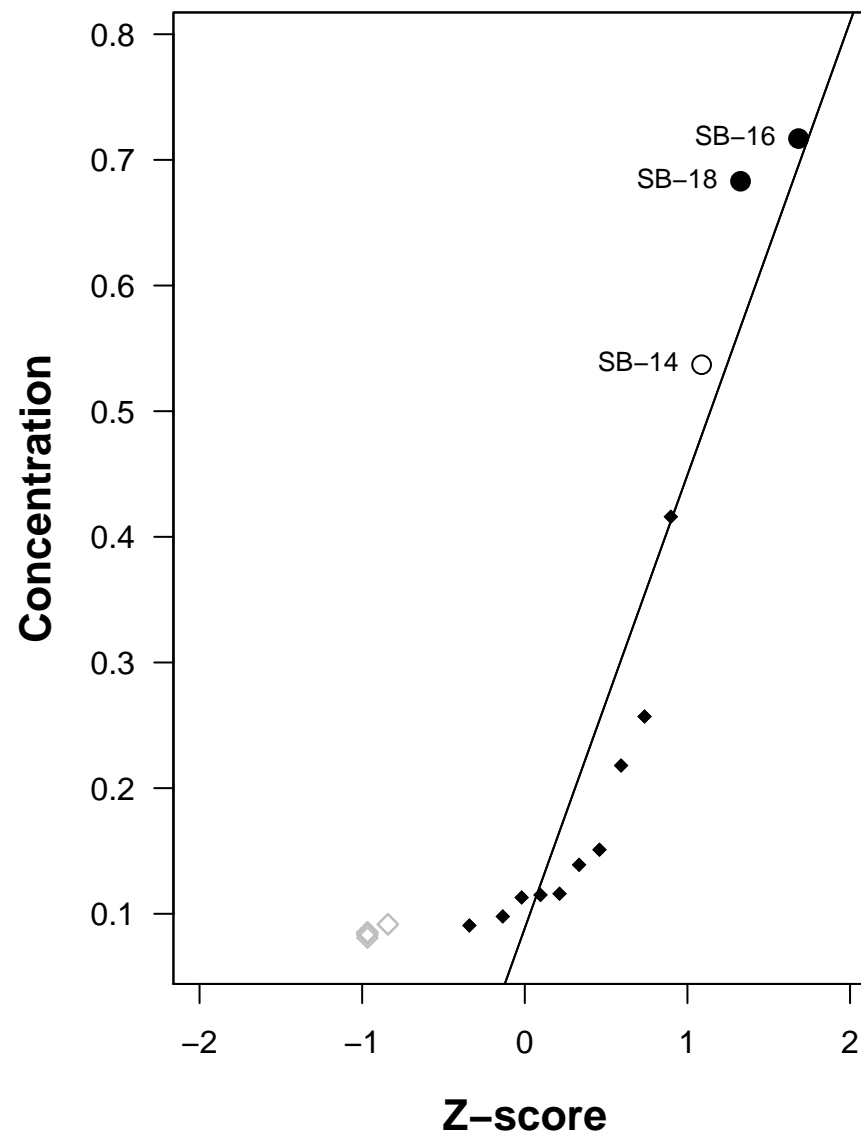
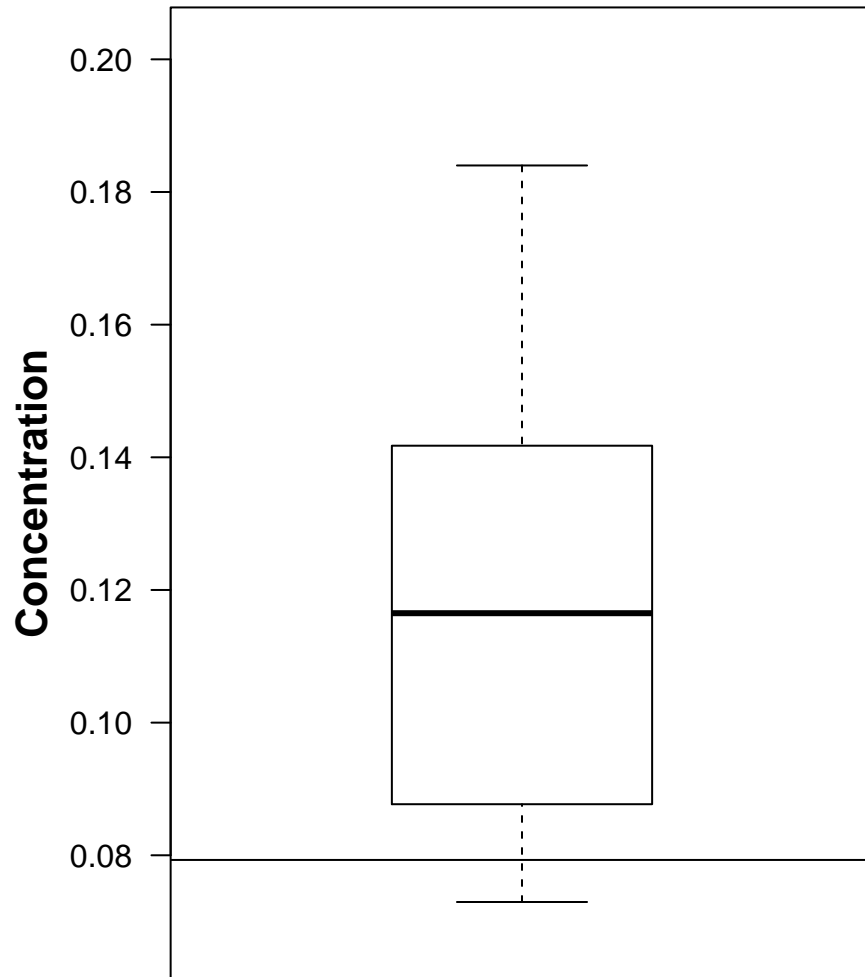


Figure B-29. SW6020, Thallium (mg/Kg)

No Tidal Influence Shallow soil (1-2 feet) samples

Det/N=17/20, Normal

Box Plot



Normal Probability Plot

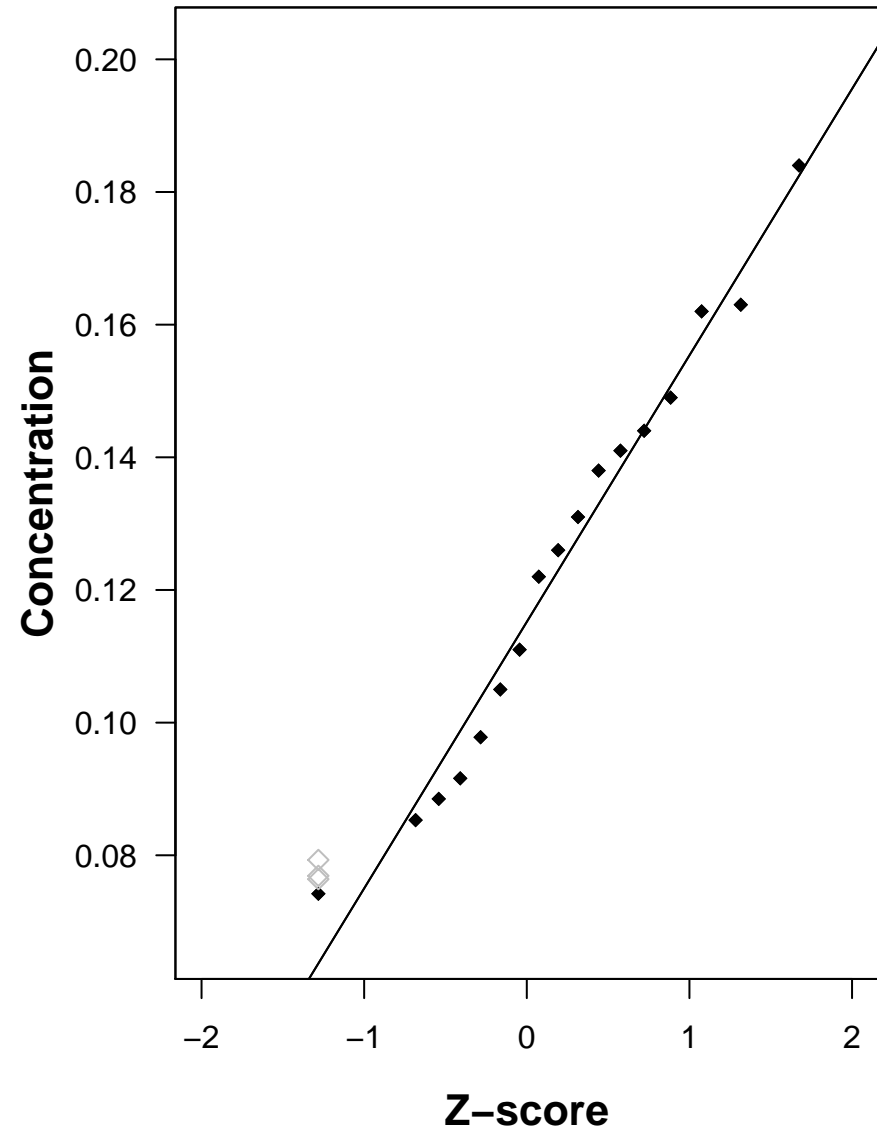
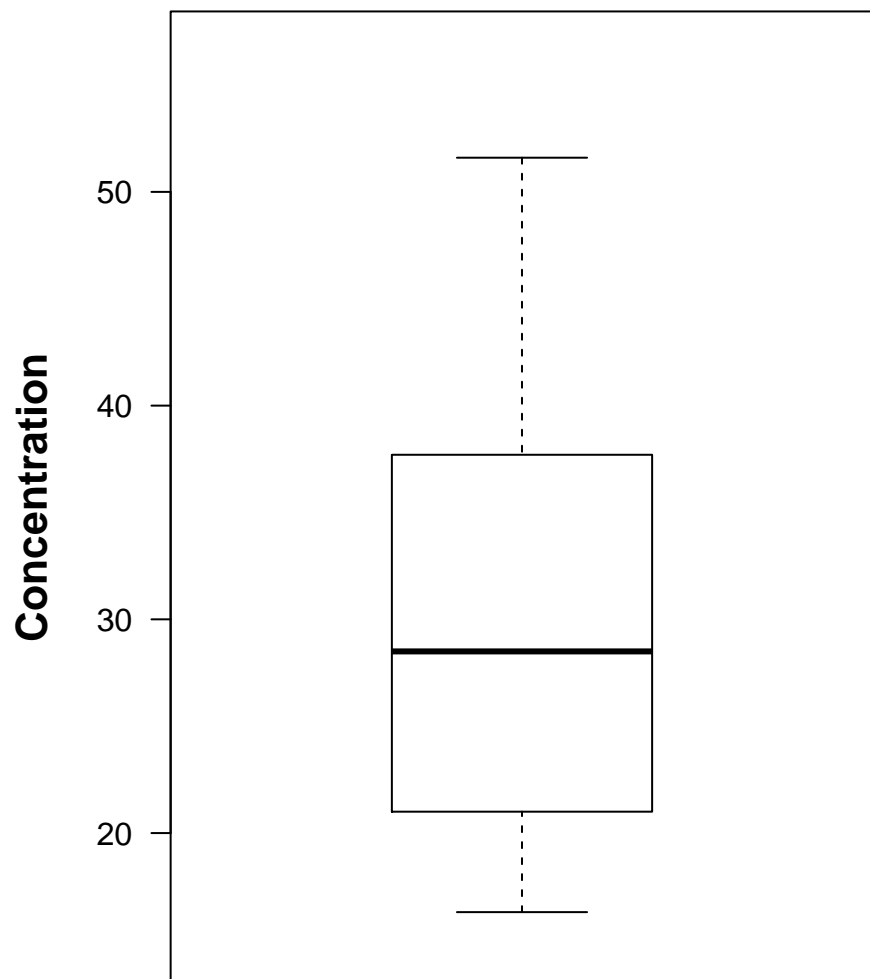


Figure B-30. SW6020, Vanadium (mg/Kg)

Shallow soil (1-2 feet) samples

Det/N=30/30, Normal

Box Plot



Normal Probability Plot

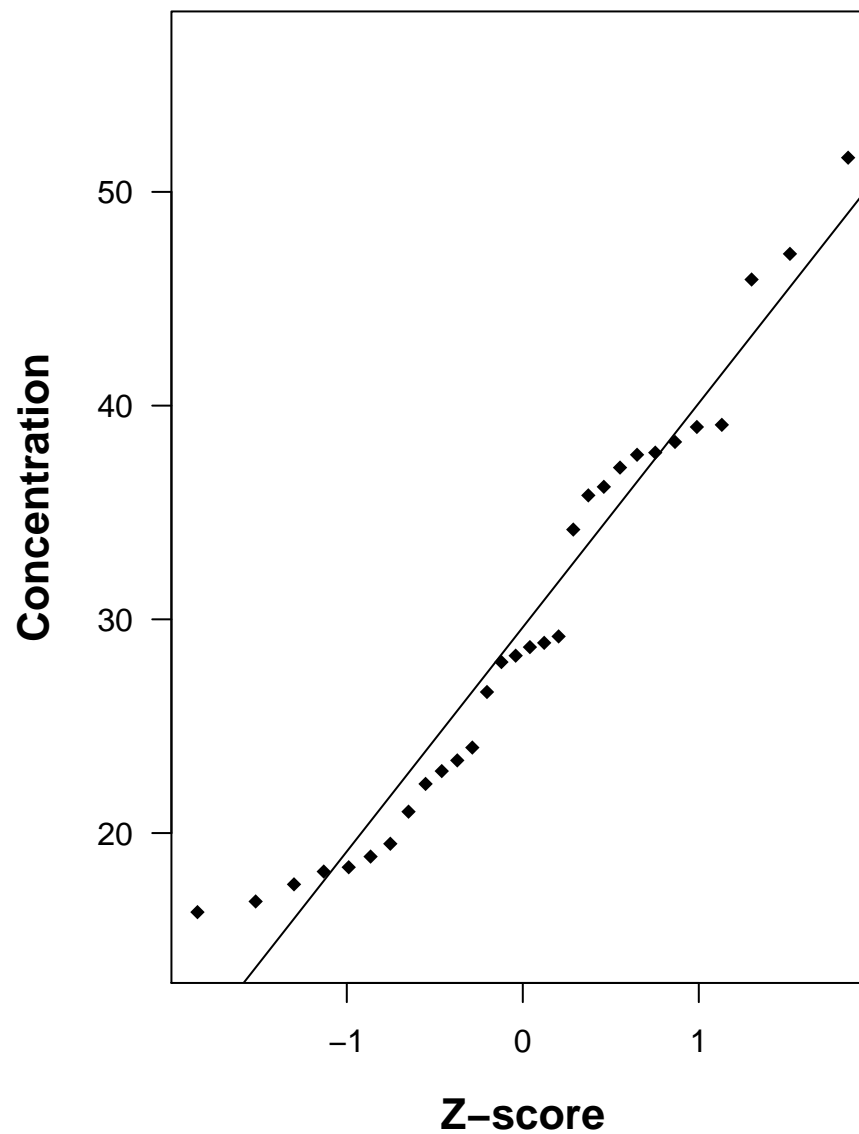
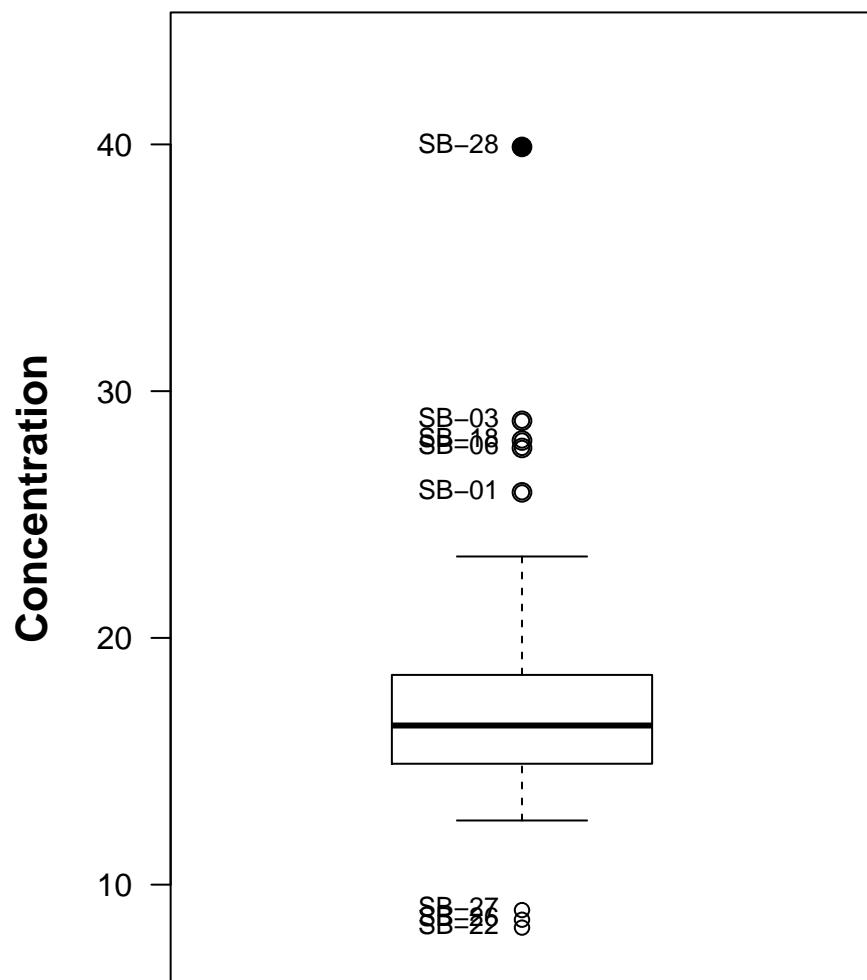


Figure B-31. SW6020, Vanadium (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=30/30, Gamma

Box Plot



Normal Probability Plot

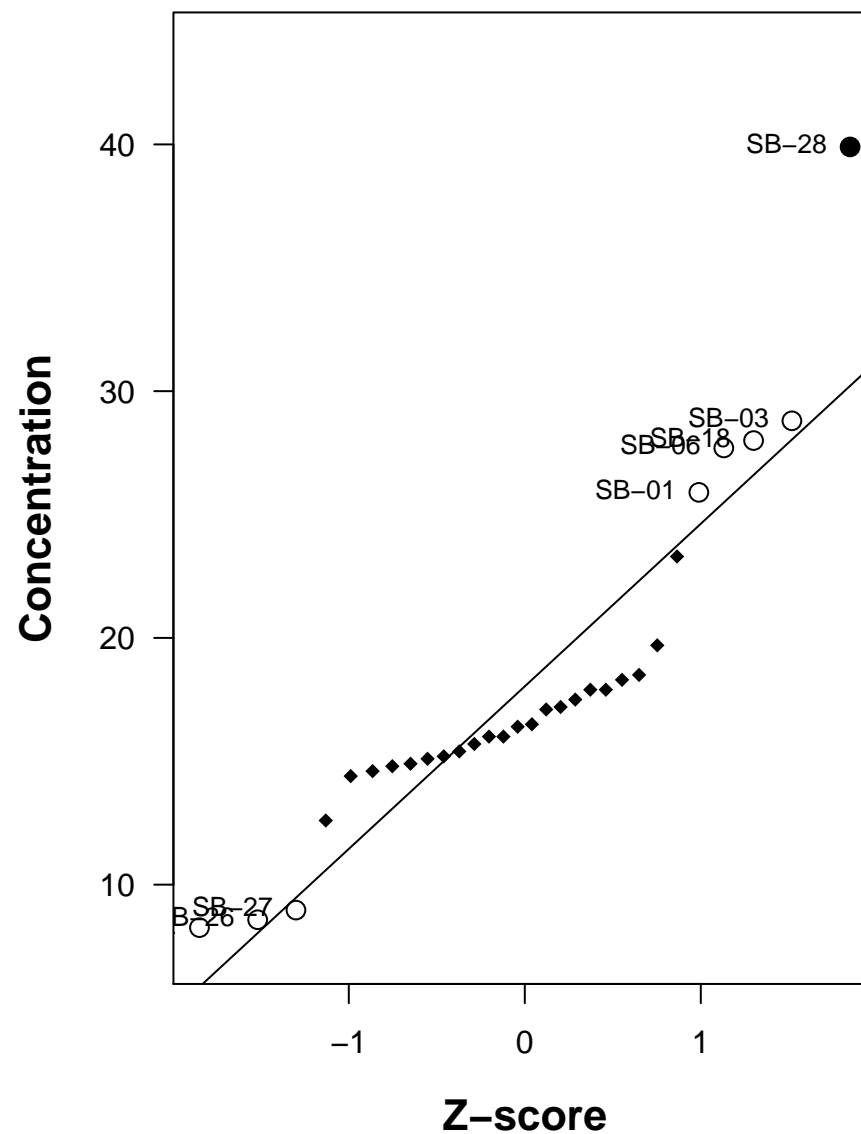
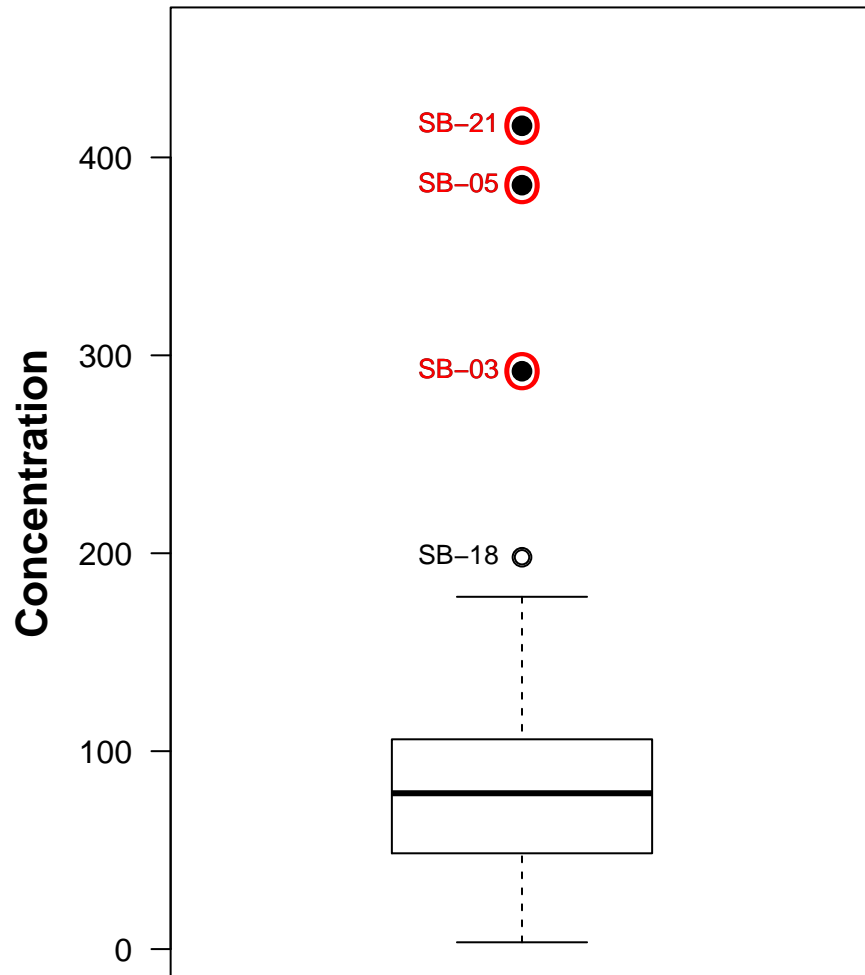


Figure B-32. SW6020, Zinc (mg/Kg)

All samples
Det/N=60/60, Gamma

Box Plot



Normal Probability Plot

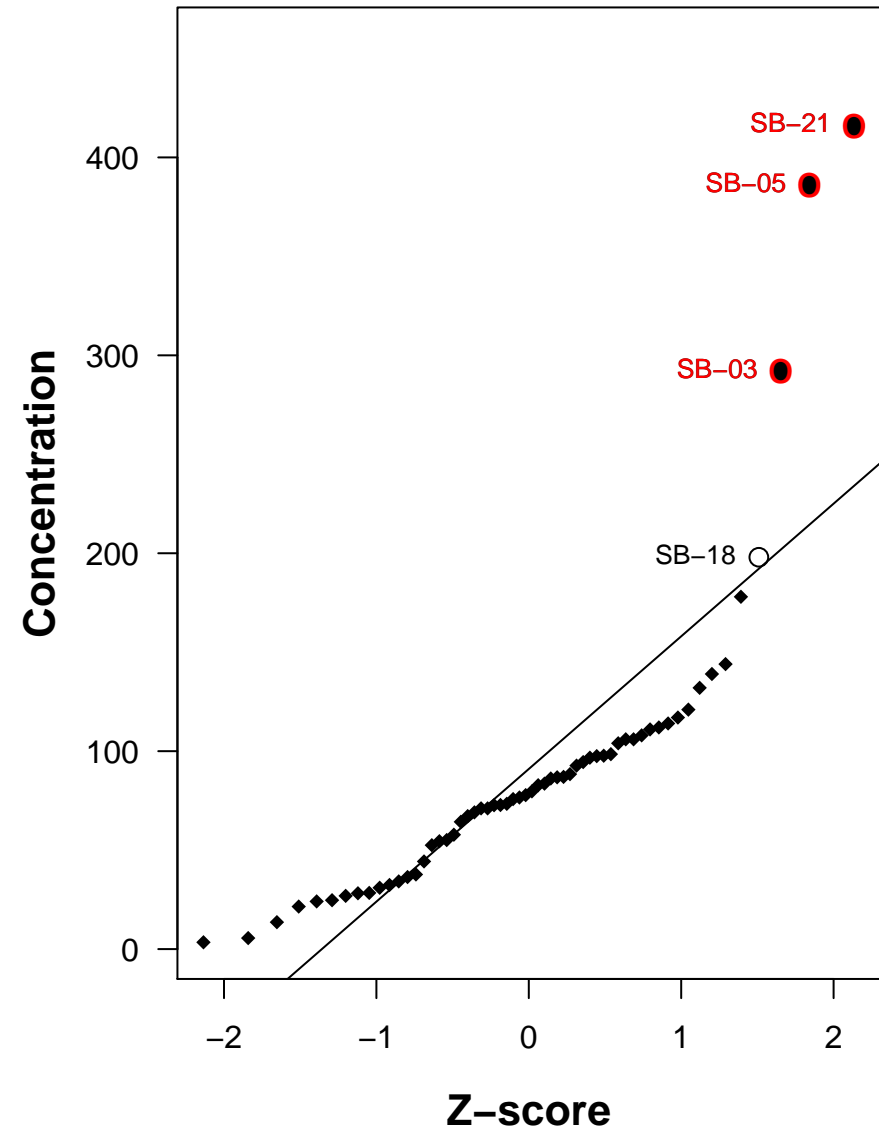
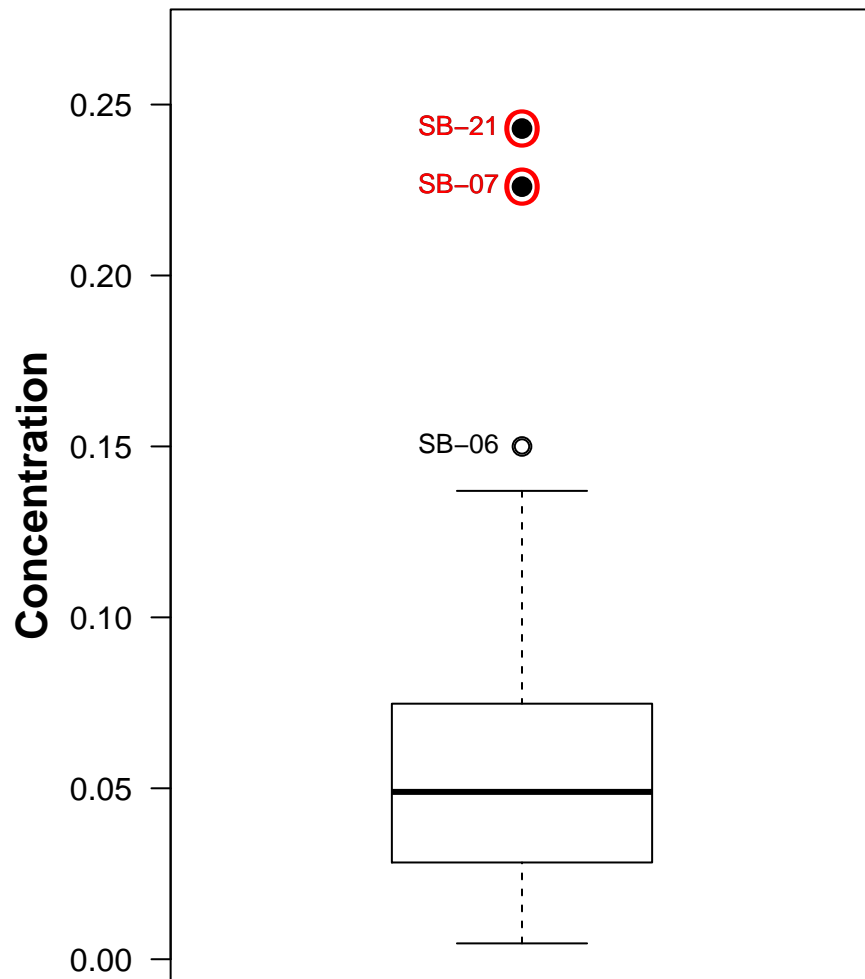


Figure B-33. SW7471A, Mercury (mg/Kg)

All samples
Det/N=60/60, Gamma

Box Plot



Normal Probability Plot

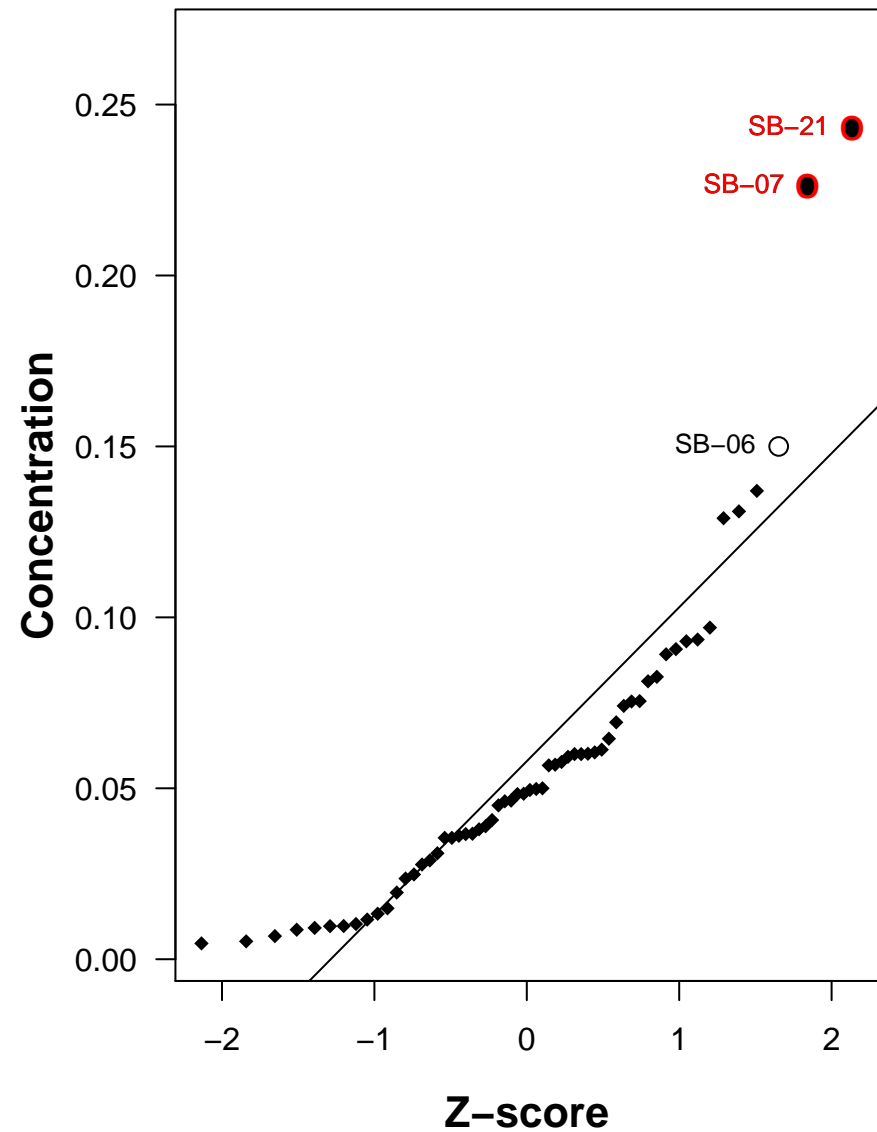
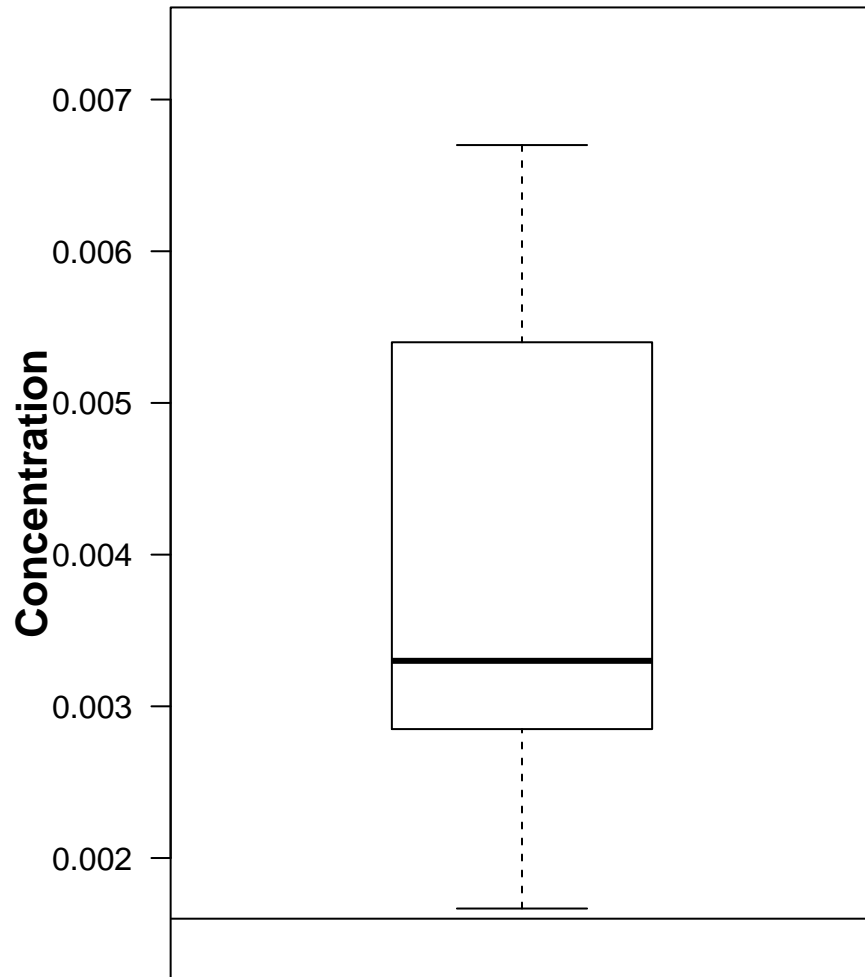


Figure B-34. SW8151, Dinoseb (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=8/10, Normal

Box Plot



Normal Probability Plot

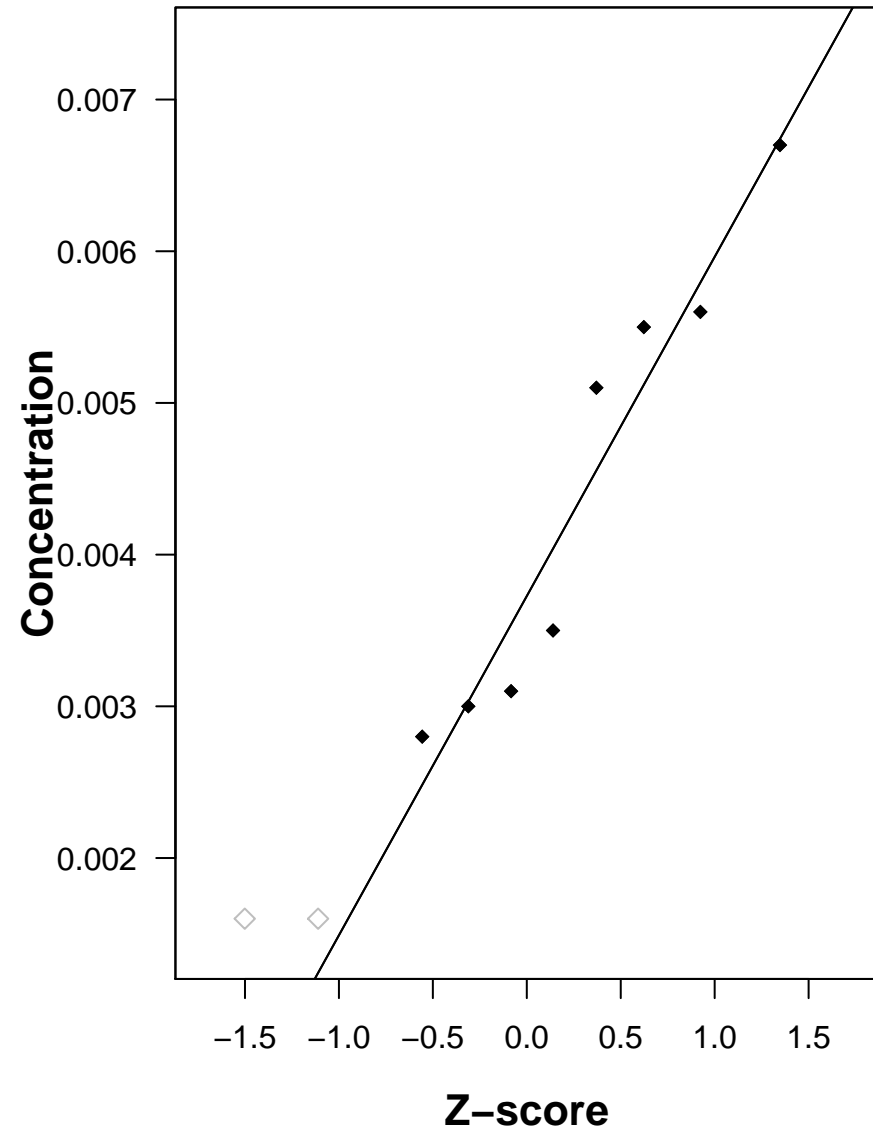
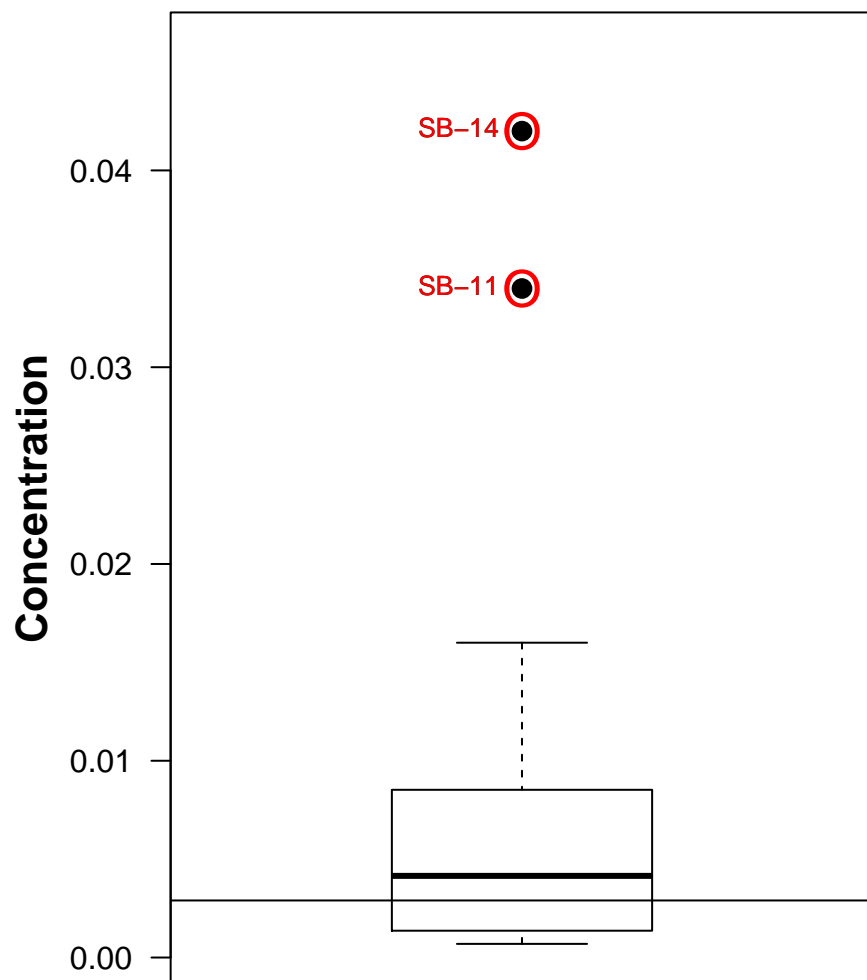


Figure B-35. SW8270, Acenaphthene (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=19/30, Lognormal

Box Plot



Normal Probability Plot

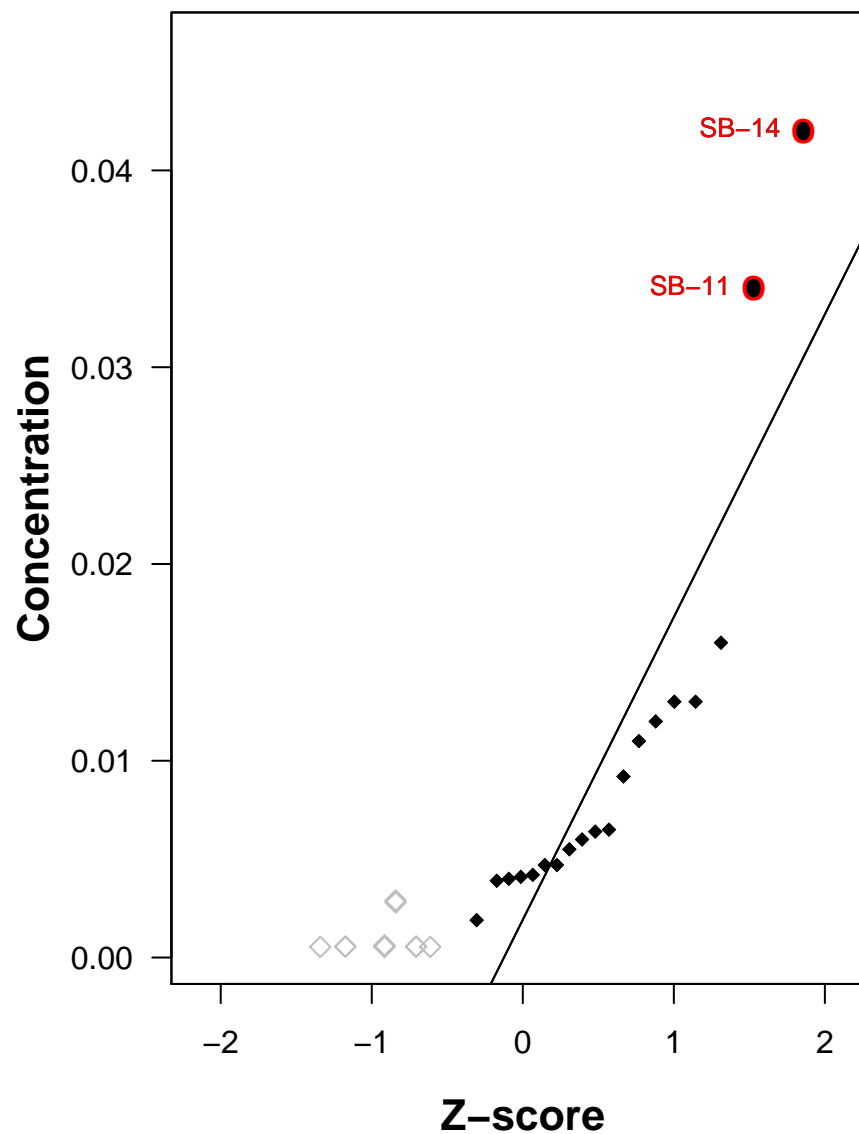
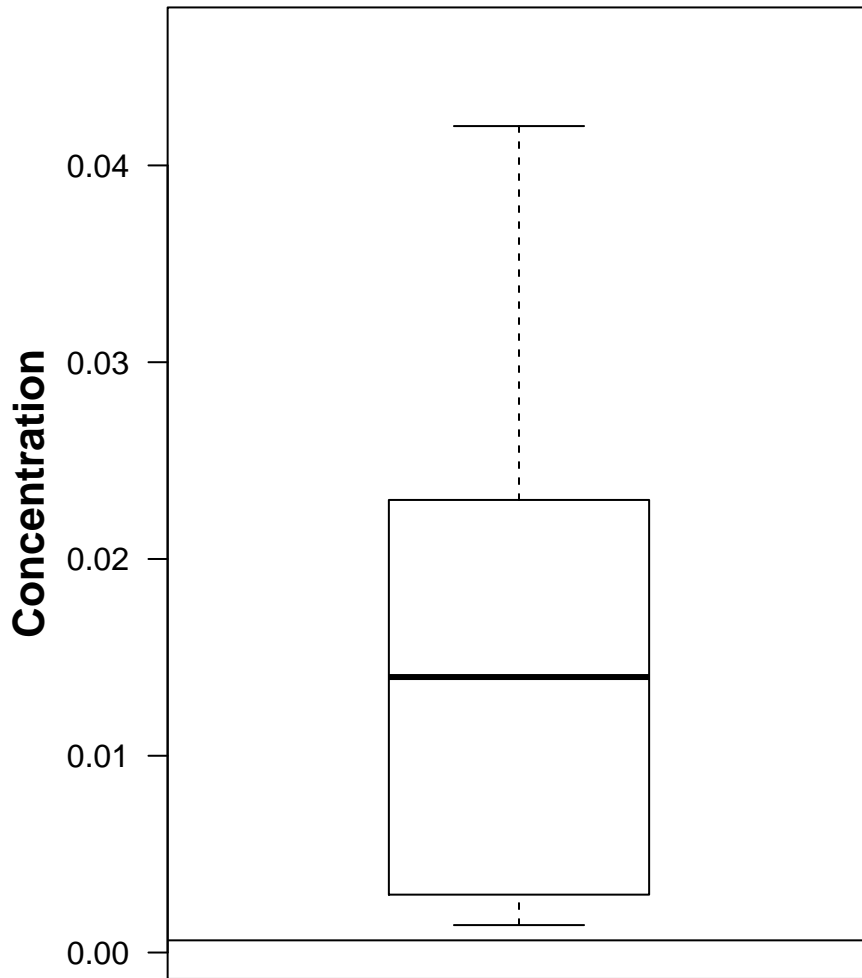


Figure B-36. SW8270, Anthracene (mg/Kg)

No Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=14/20, Normal

Box Plot



Normal Probability Plot

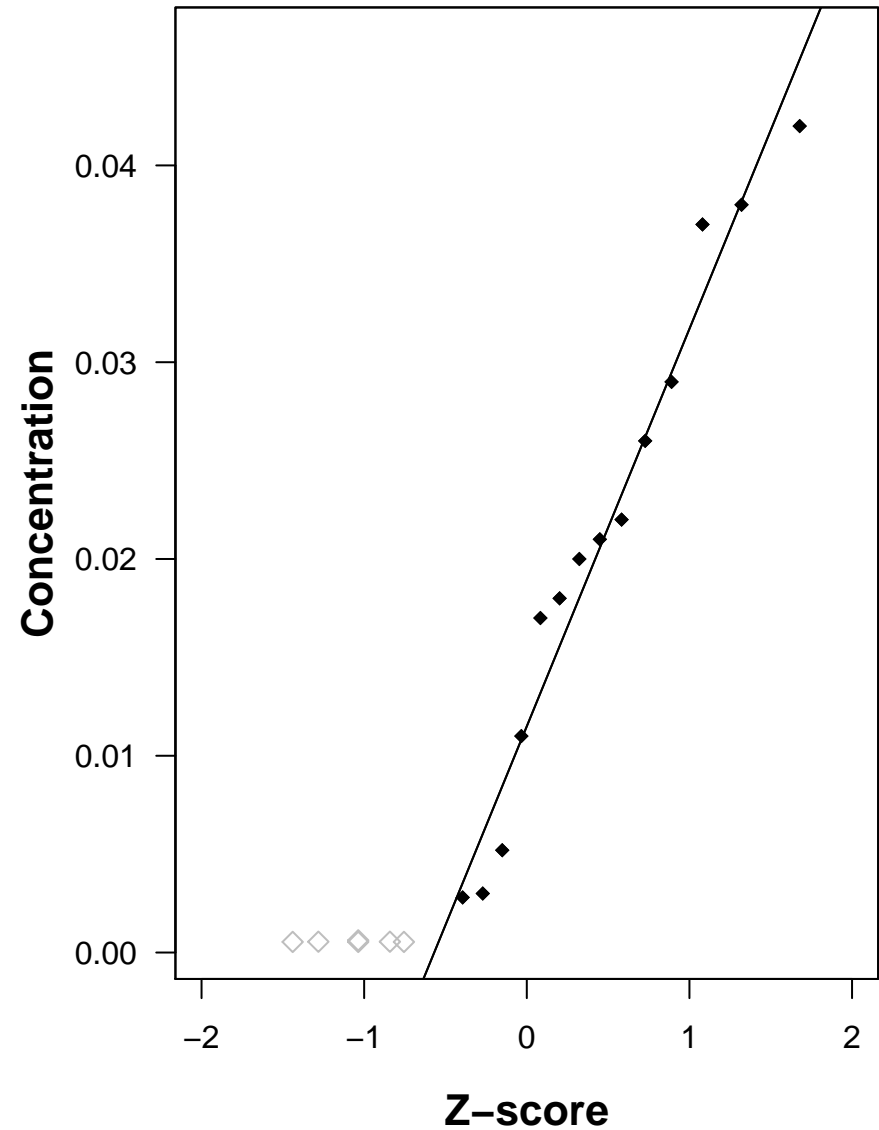
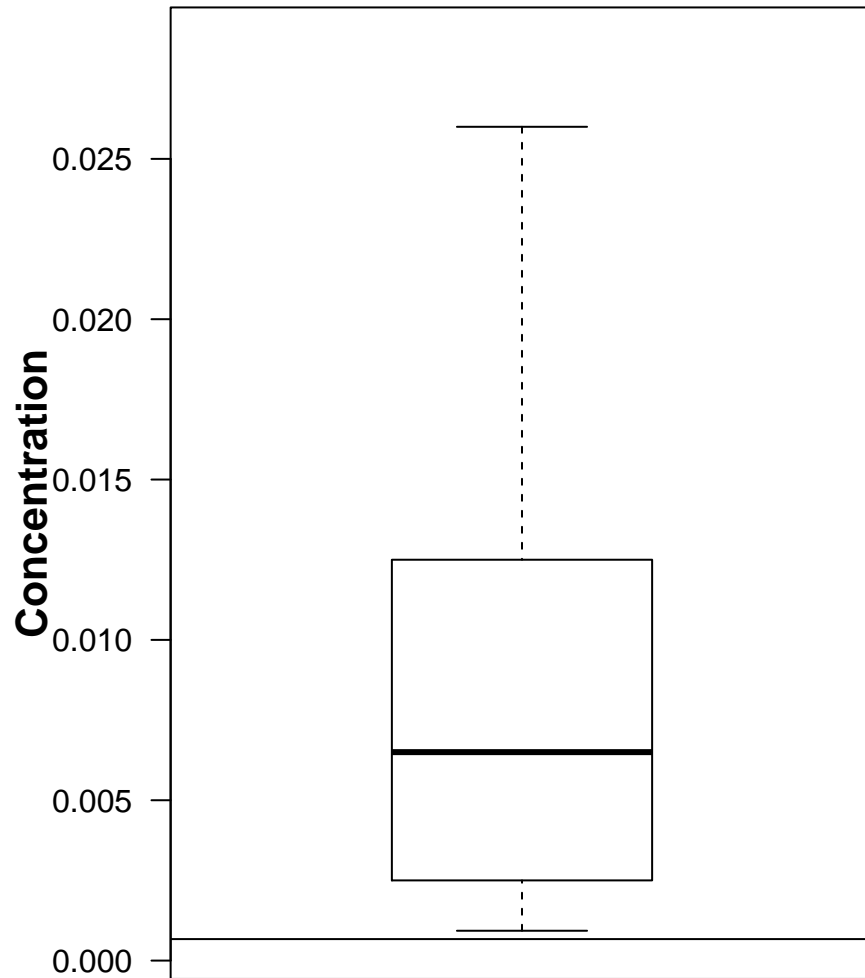


Figure B-37. SW8270, Anthracene (mg/Kg)

Tidal Influence Shallow soil (1-2 feet) samples

Det/N=8/10, Normal

Box Plot



Normal Probability Plot

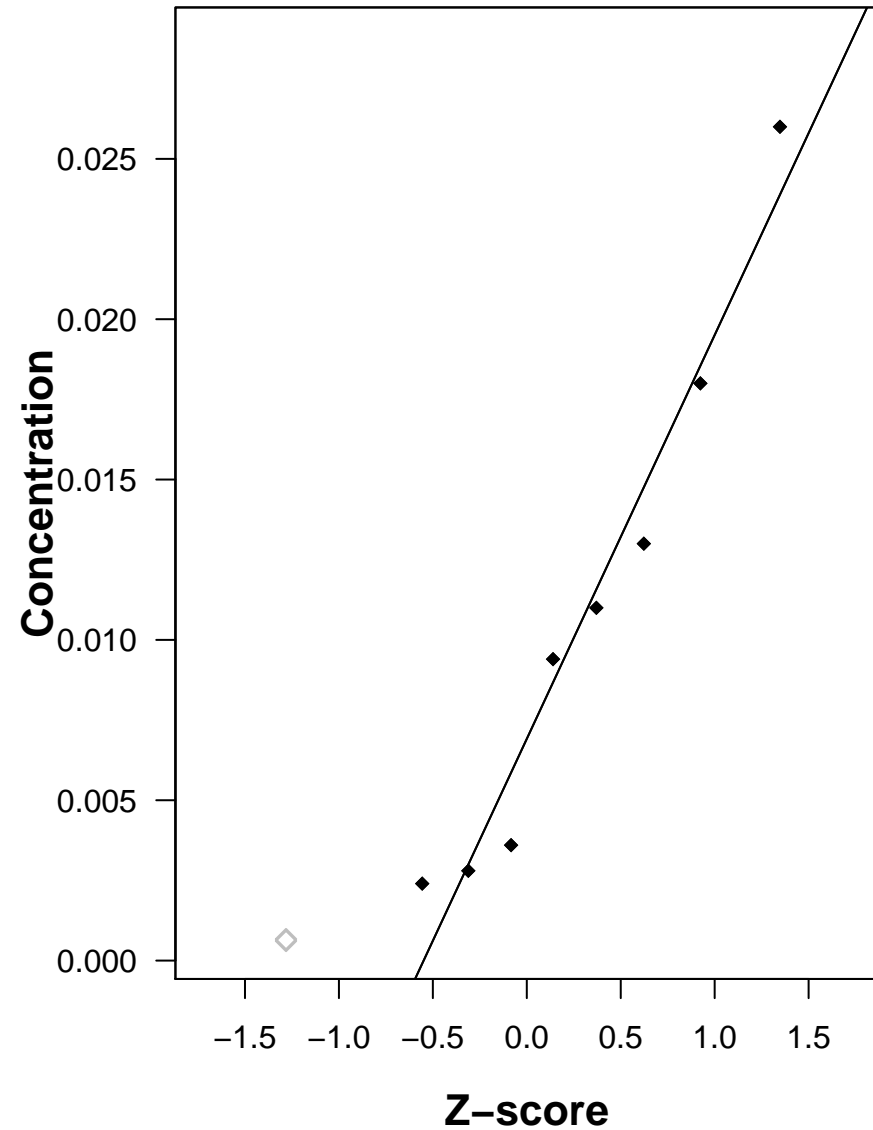
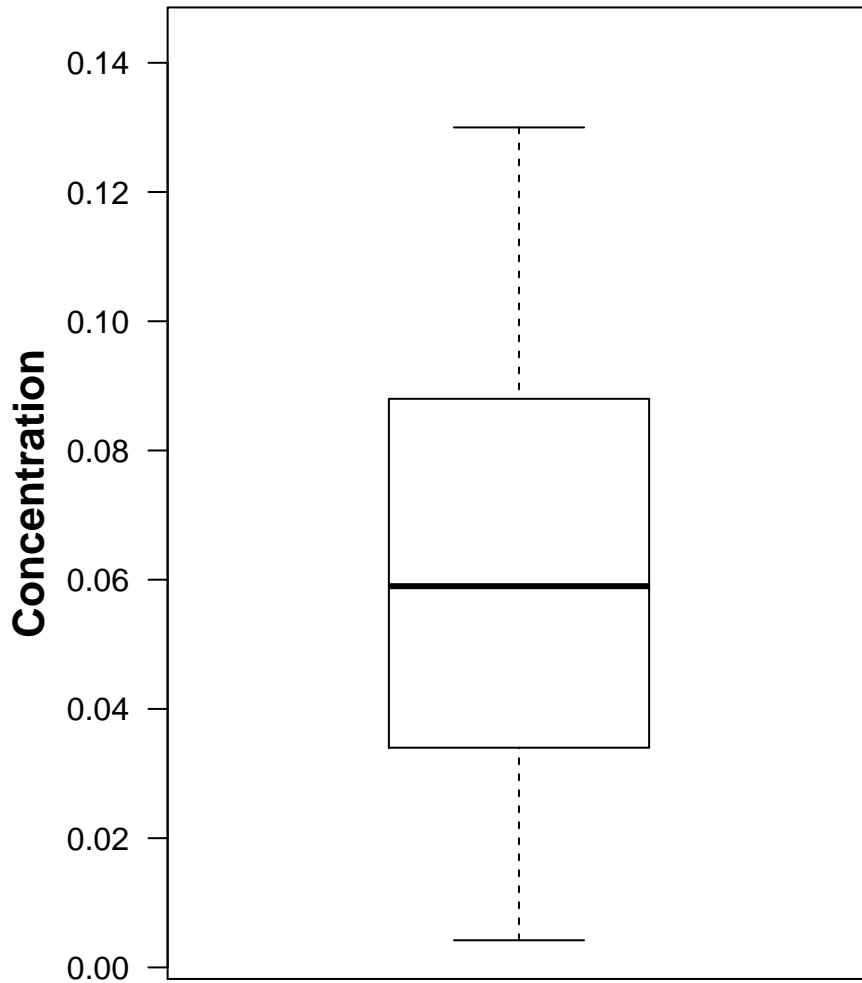


Figure B–38. SW8270, Anthracene (mg/Kg)

Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

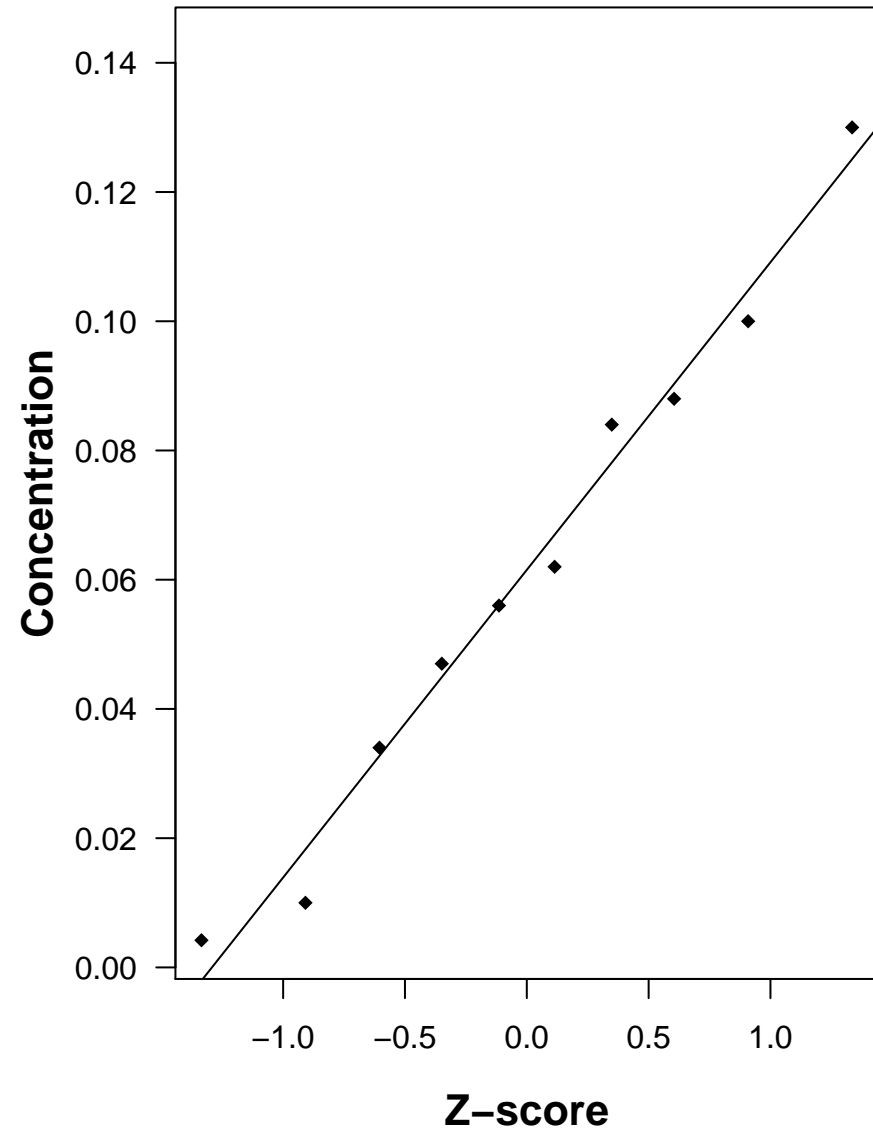
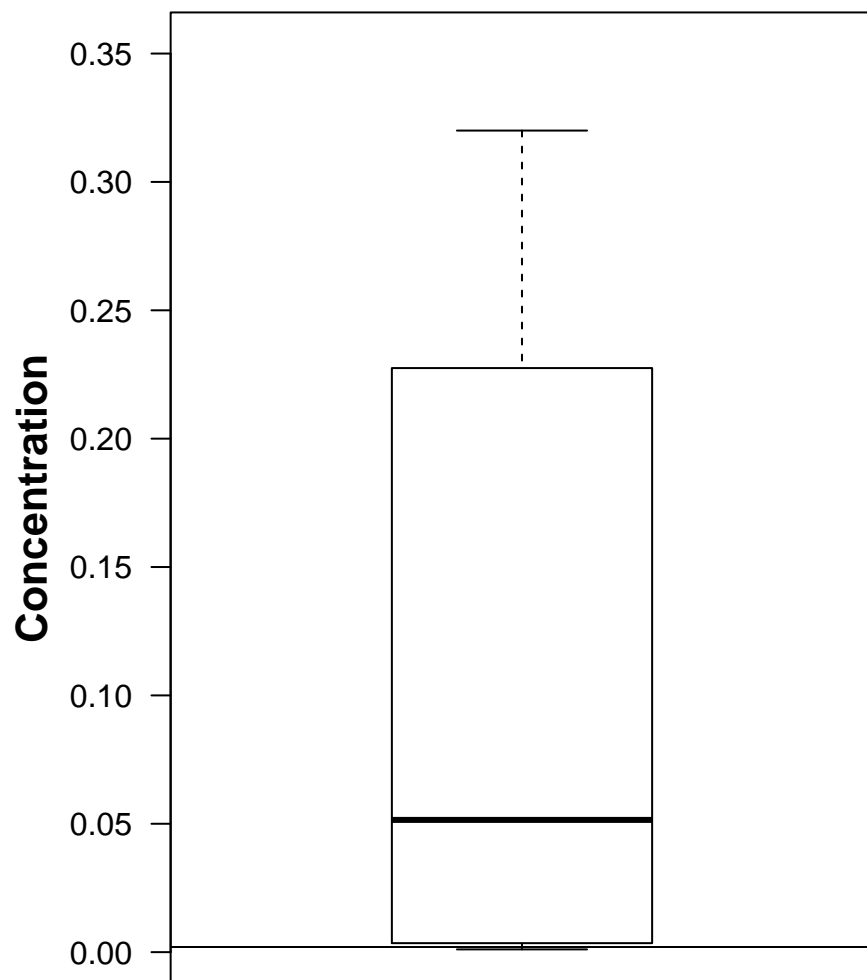


Figure B-39. SW8270, Benz(a)anthracene (mg/Kg)

No Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=19/20, Gamma

Box Plot



Normal Probability Plot

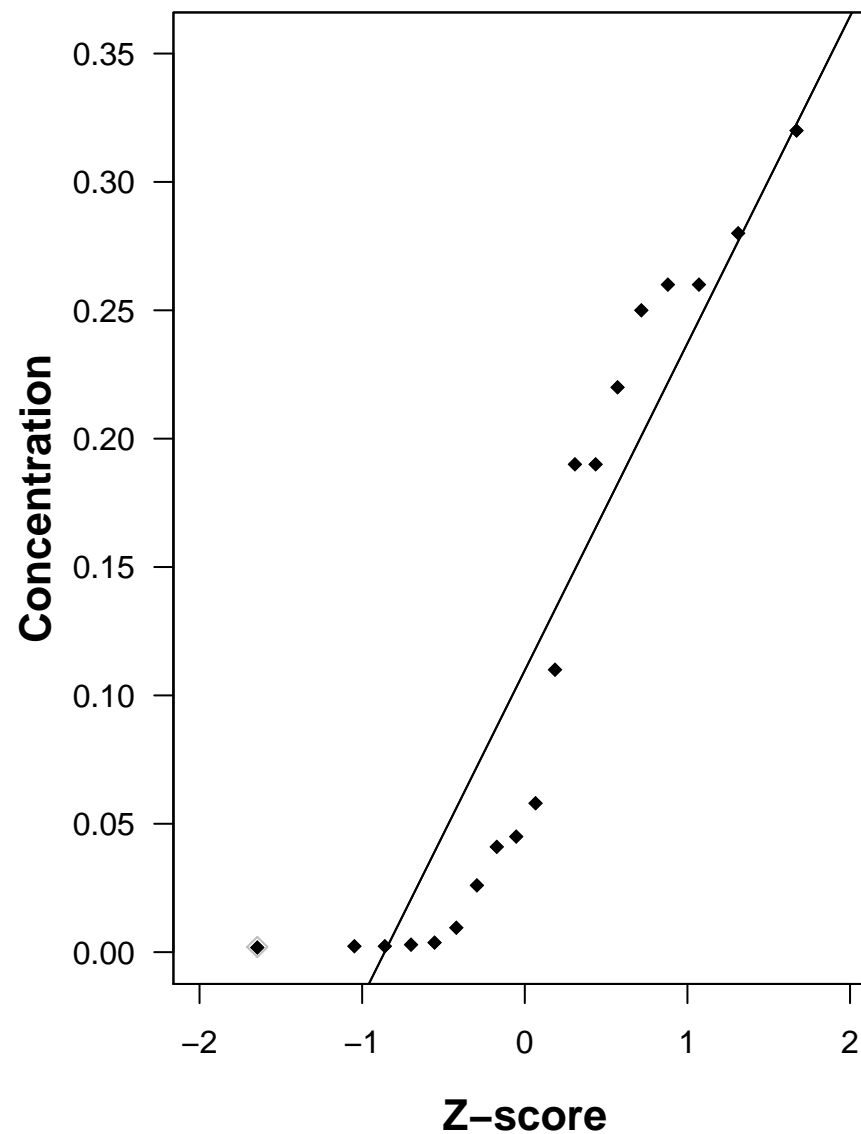
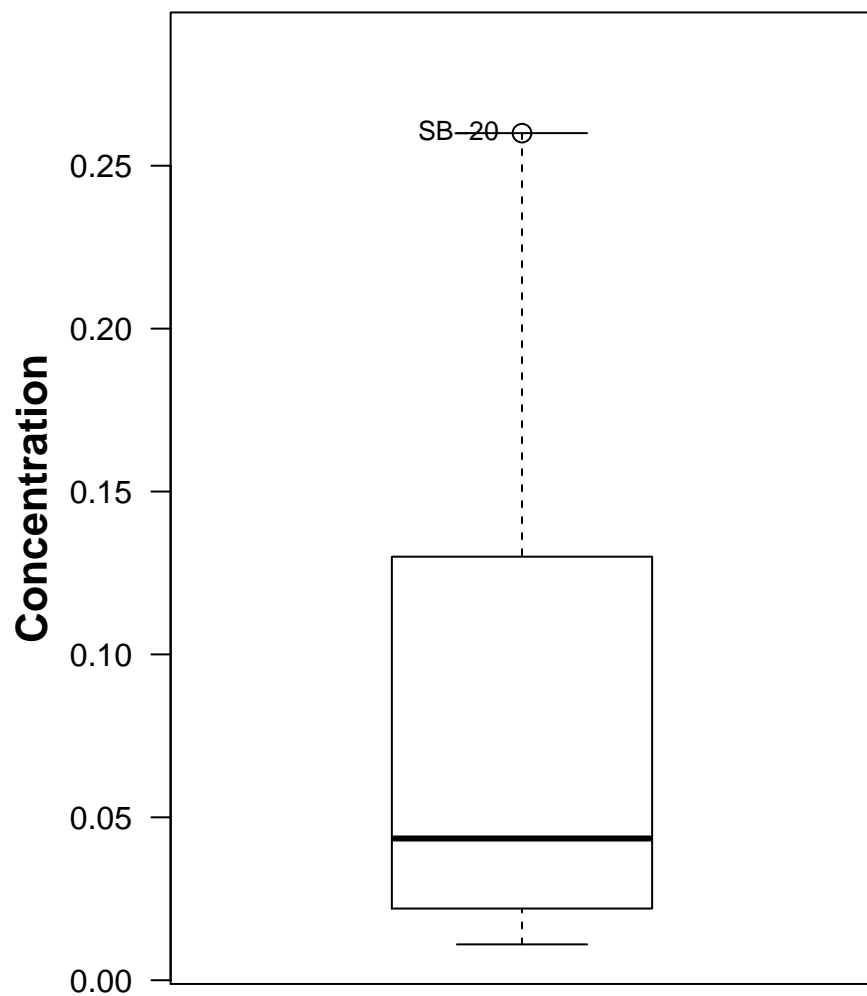


Figure B-40. SW8270, Benz(a)anthracene (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

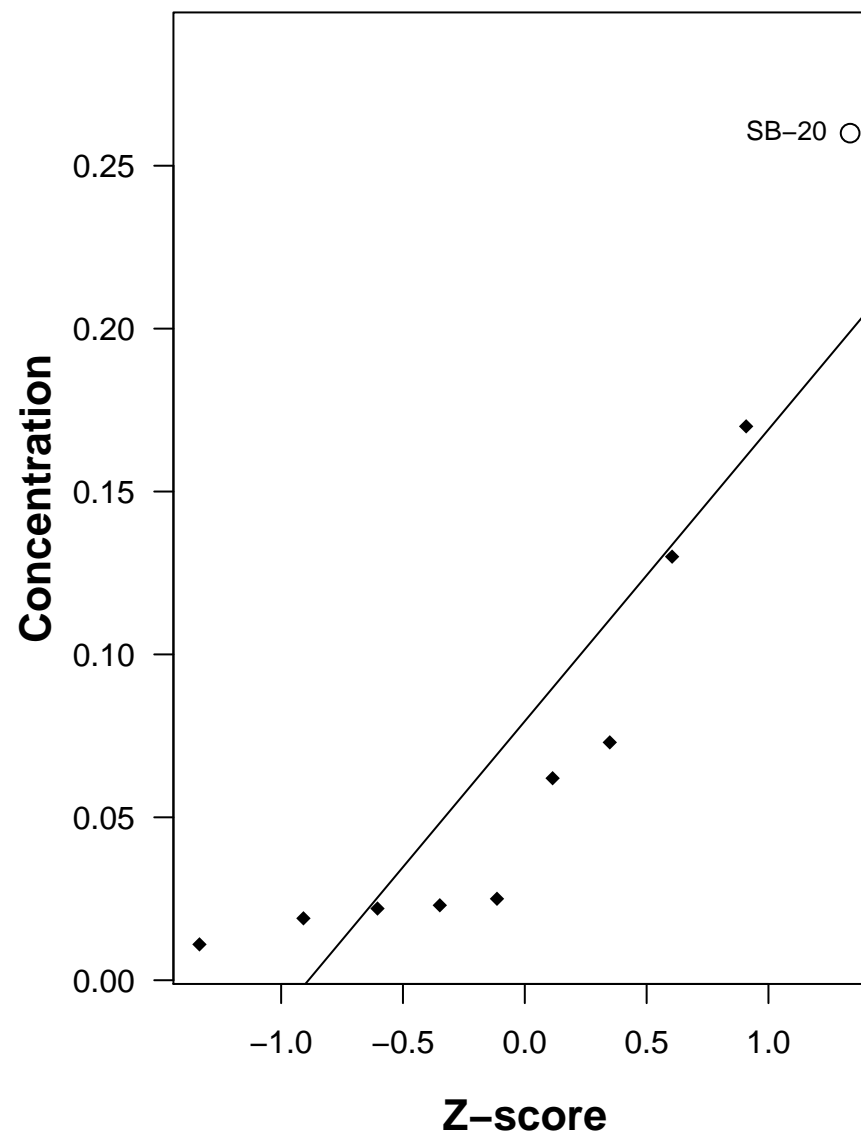
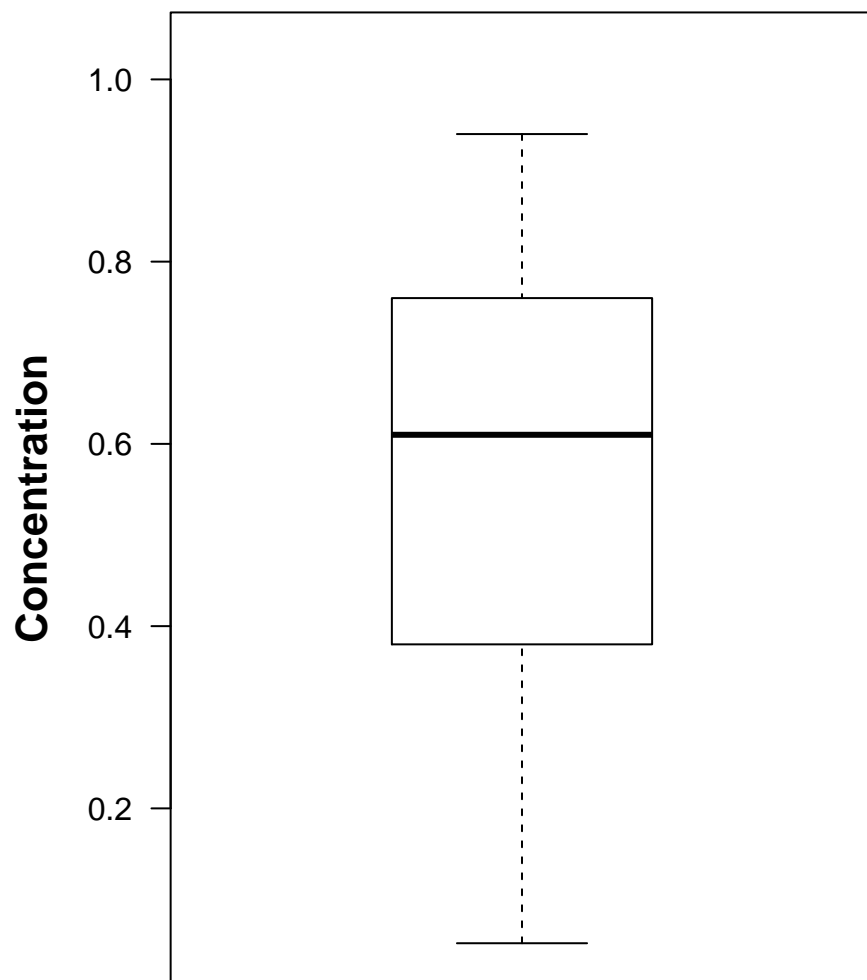


Figure B-41. SW8270, Benz(a)anthracene (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

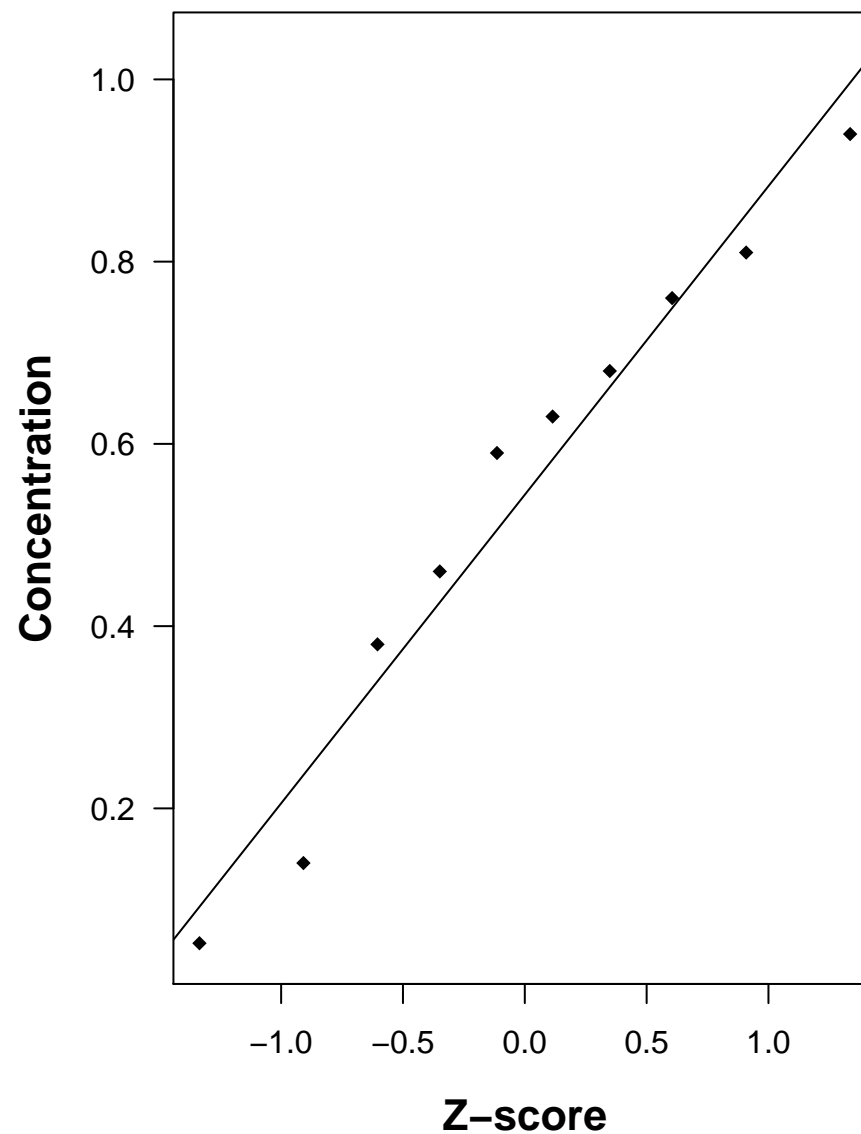
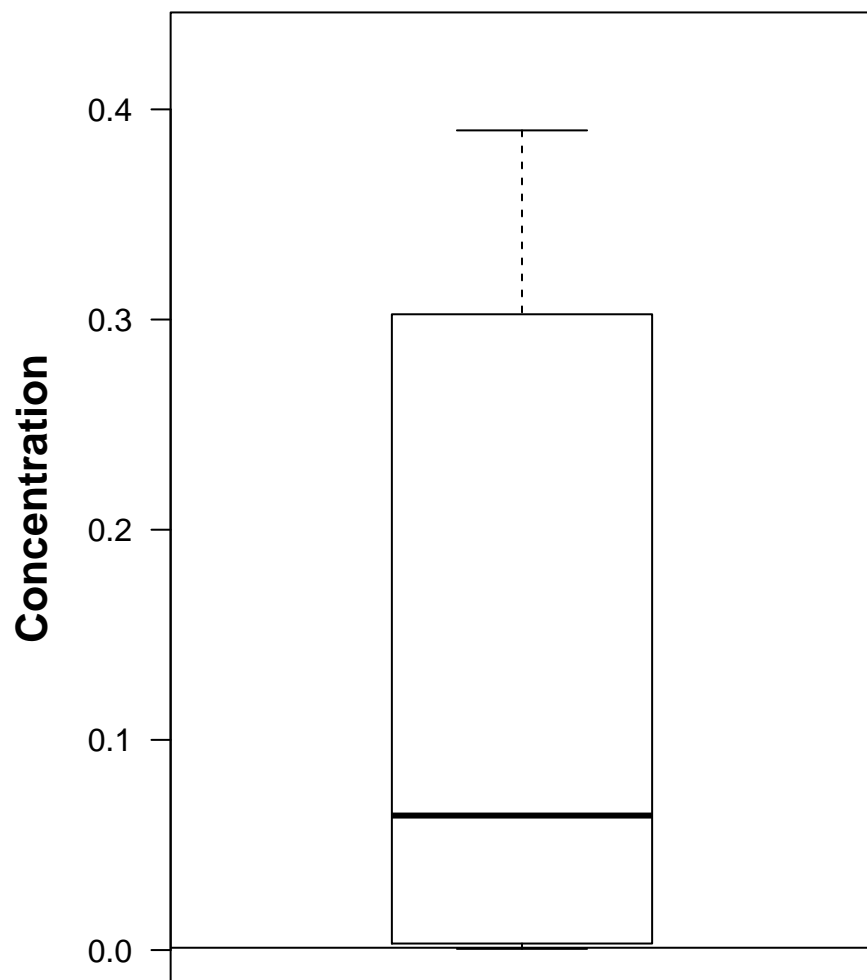


Figure B-42. SW8270, Benzo(a)pyrene (mg/Kg)

No Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=18/20, Gamma

Box Plot



Normal Probability Plot

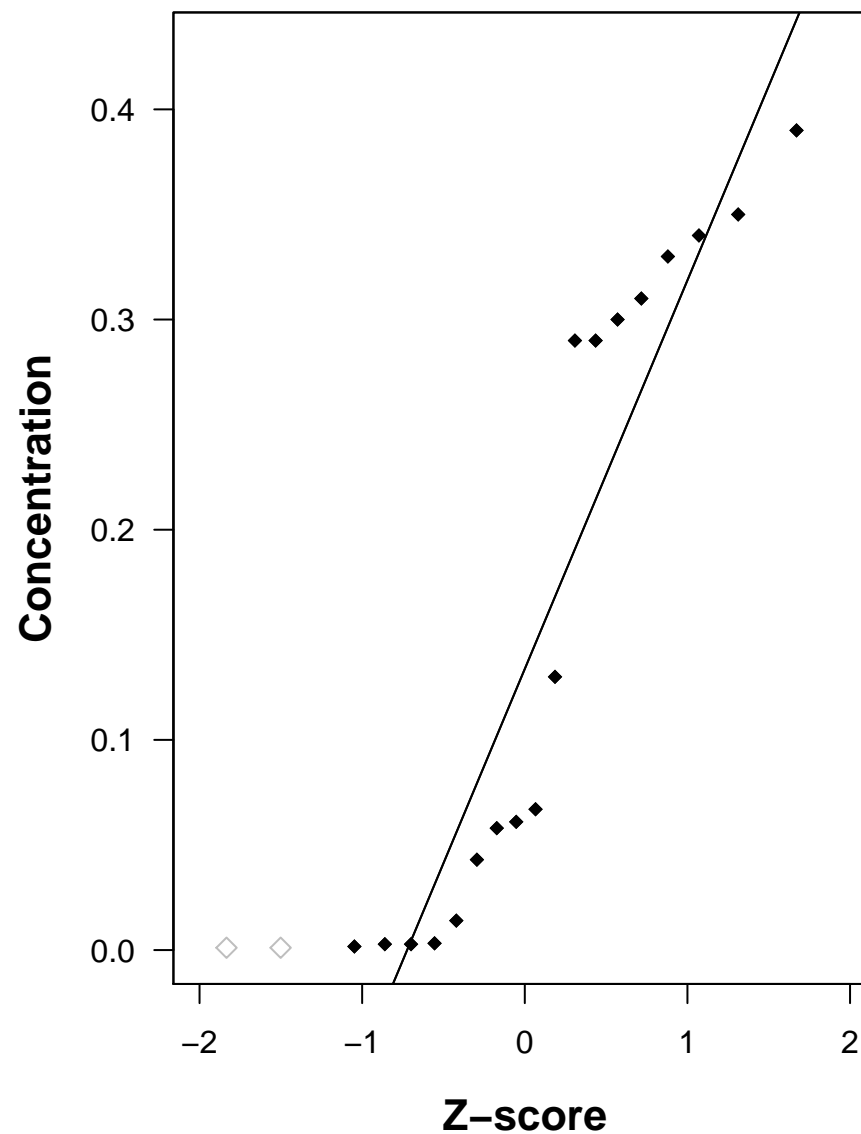
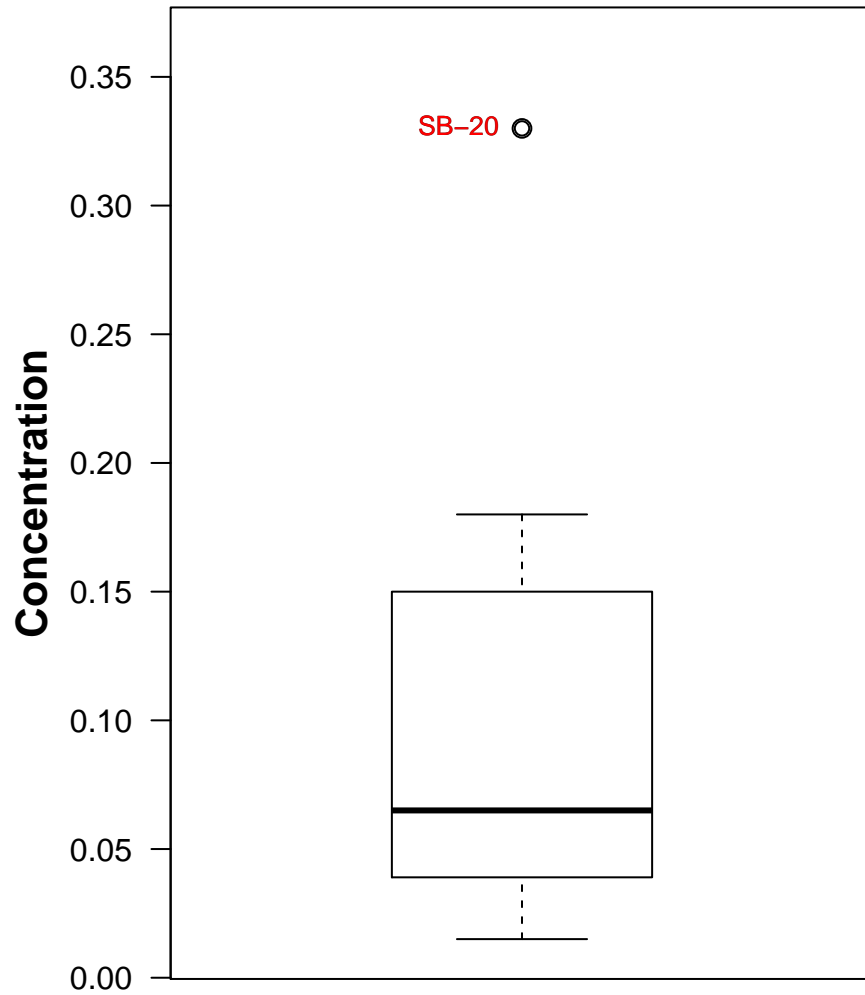


Figure B-43. SW8270, Benzo(a)pyrene (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

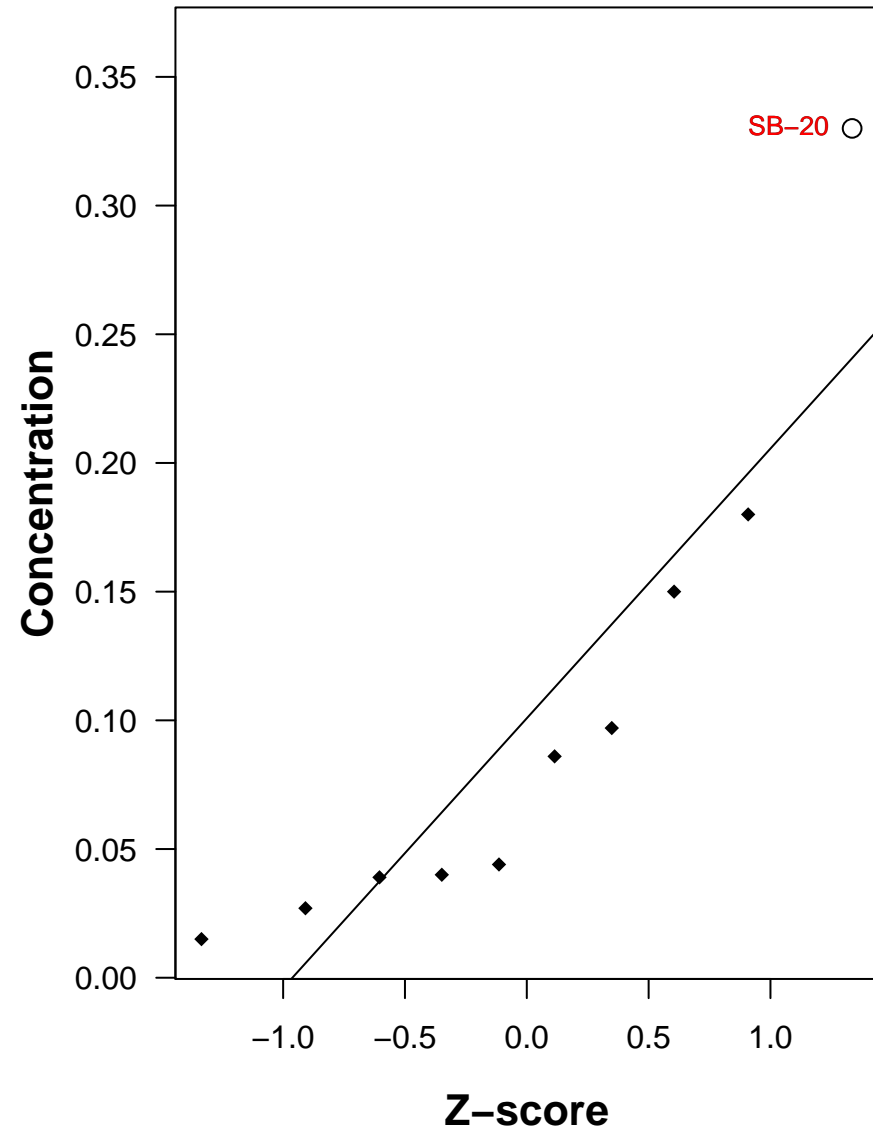
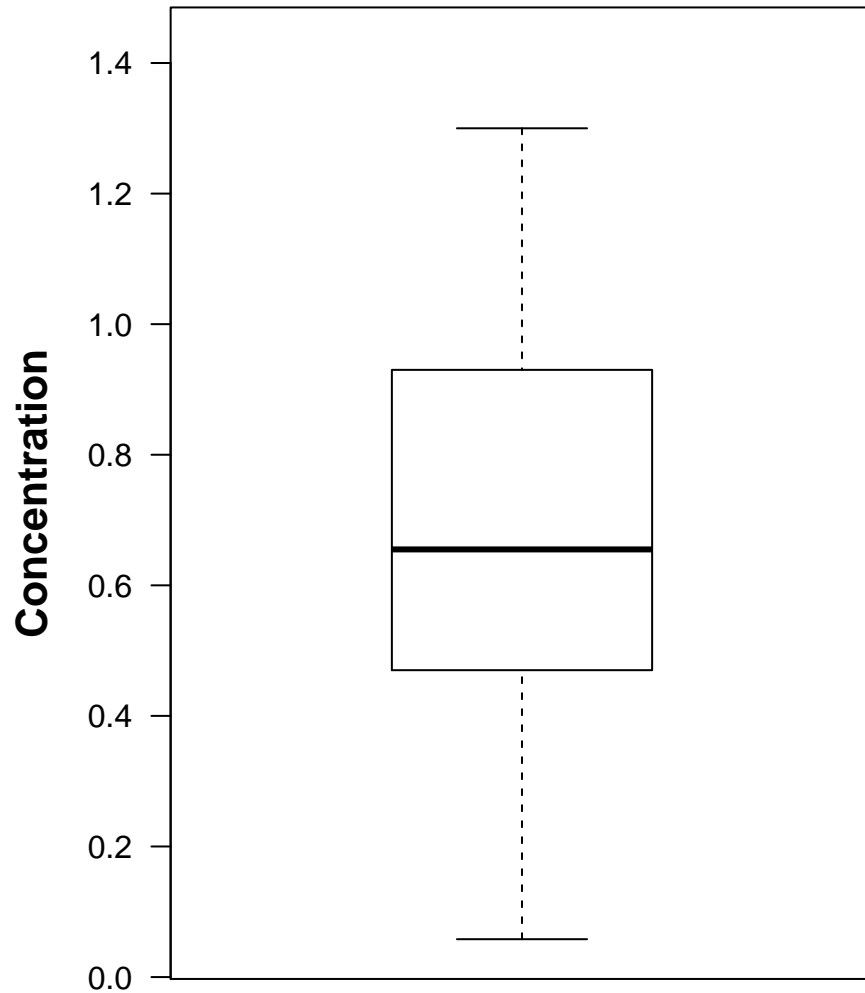


Figure B-44. SW8270, Benzo(a)pyrene (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

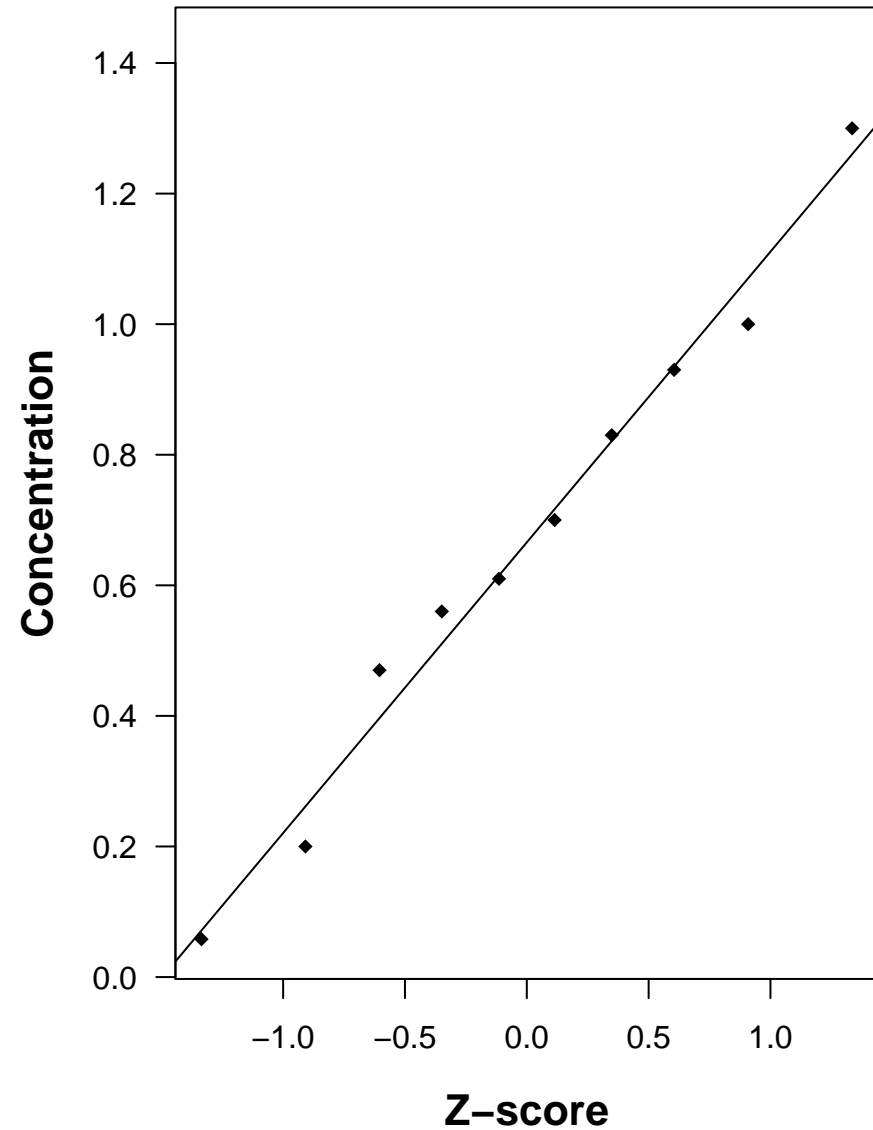
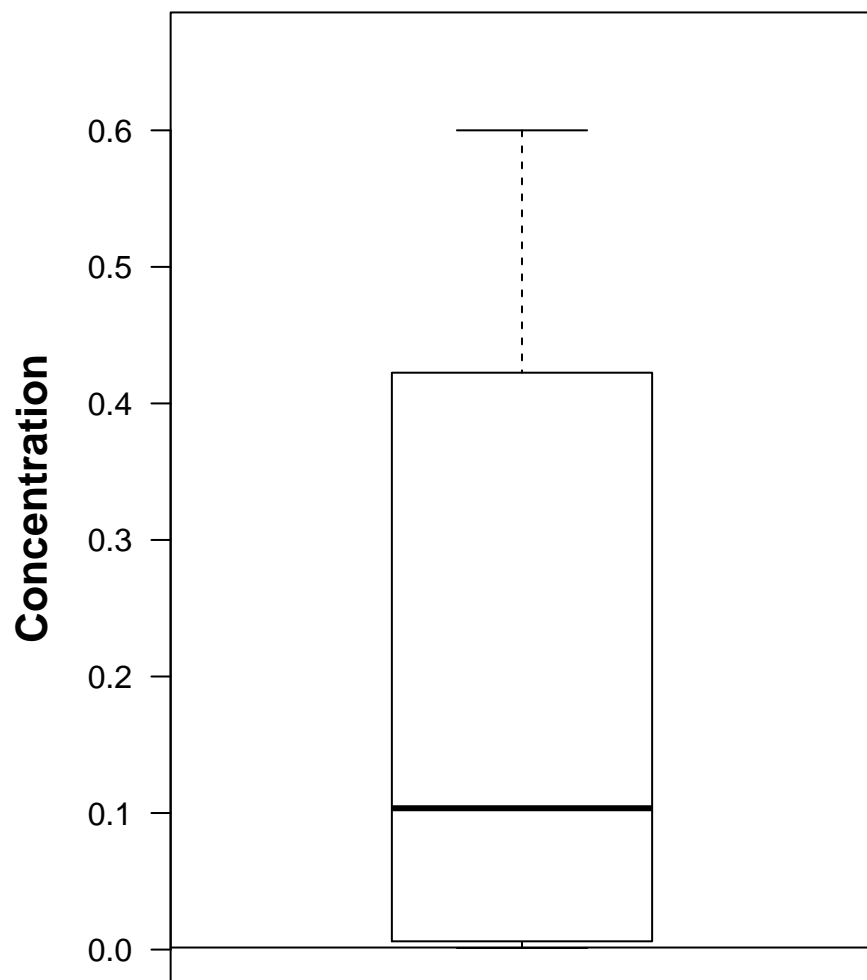


Figure B-45. SW8270, Benzo(b)fluoranthene (mg/Kg)

No Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=18/20, Gamma

Box Plot



Normal Probability Plot

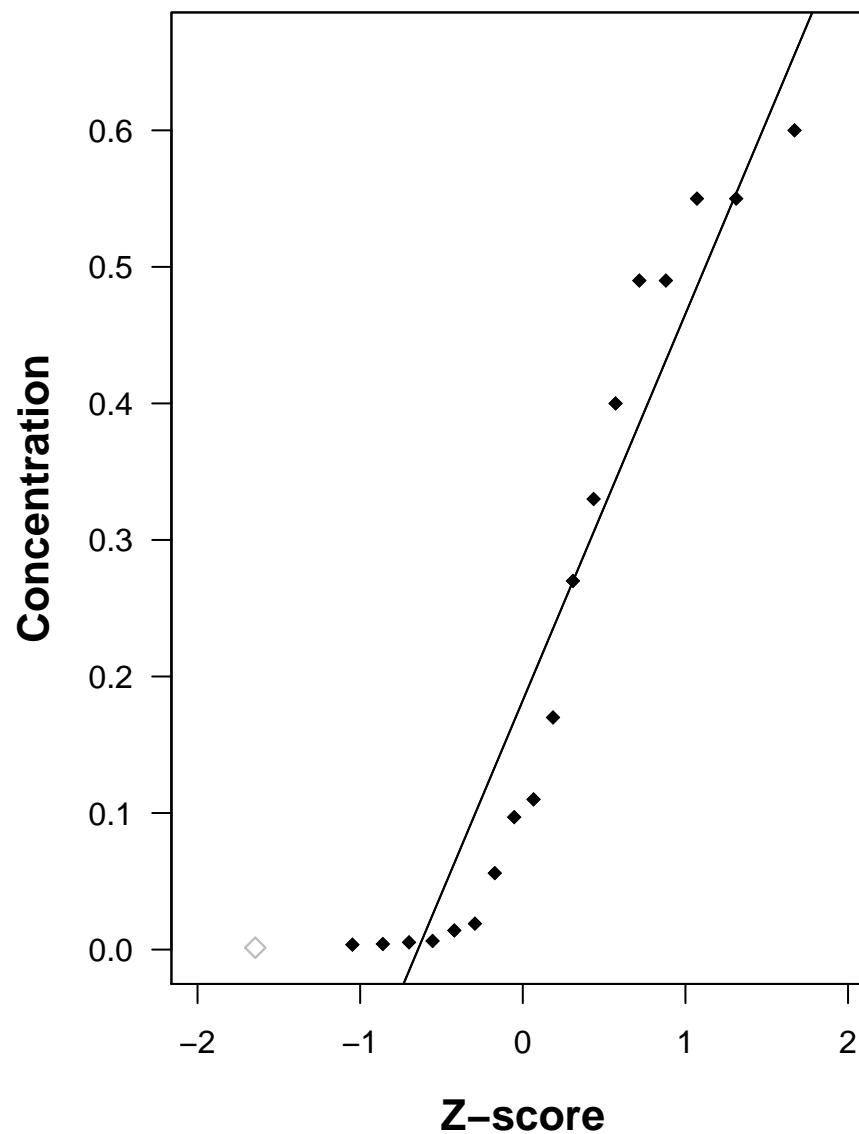
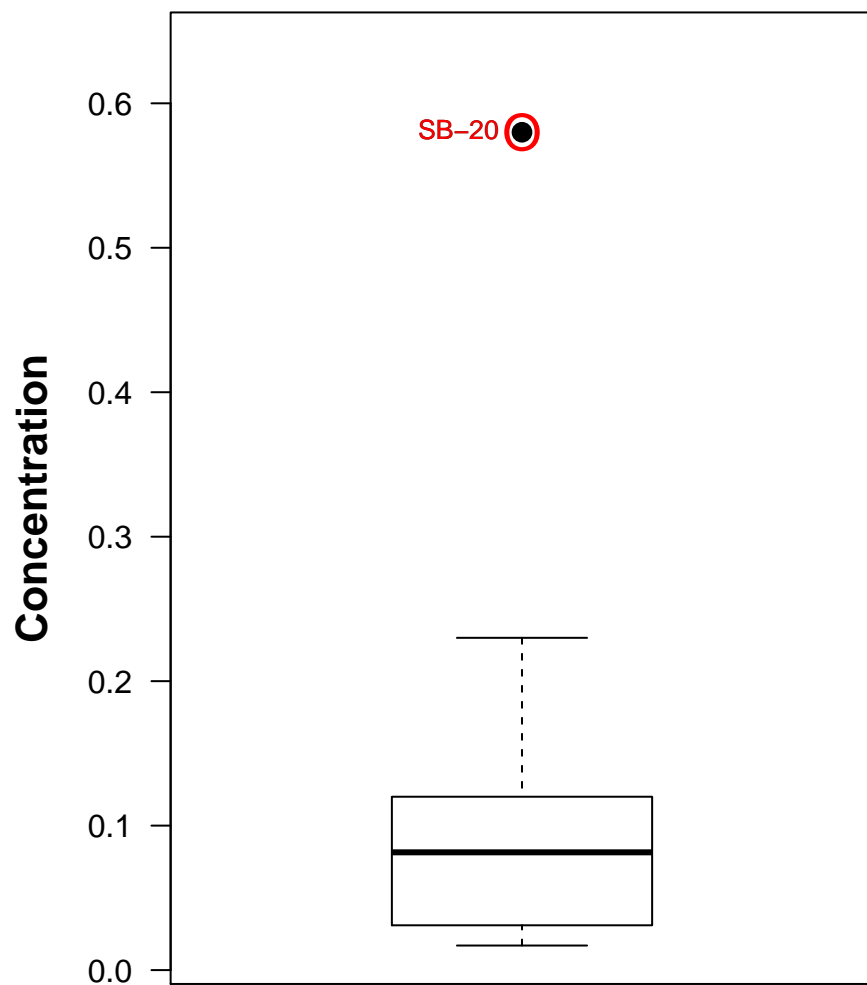


Figure B-46. SW8270, Benzo(b)fluoranthene (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=10/10, Gamma

Box Plot



Normal Probability Plot

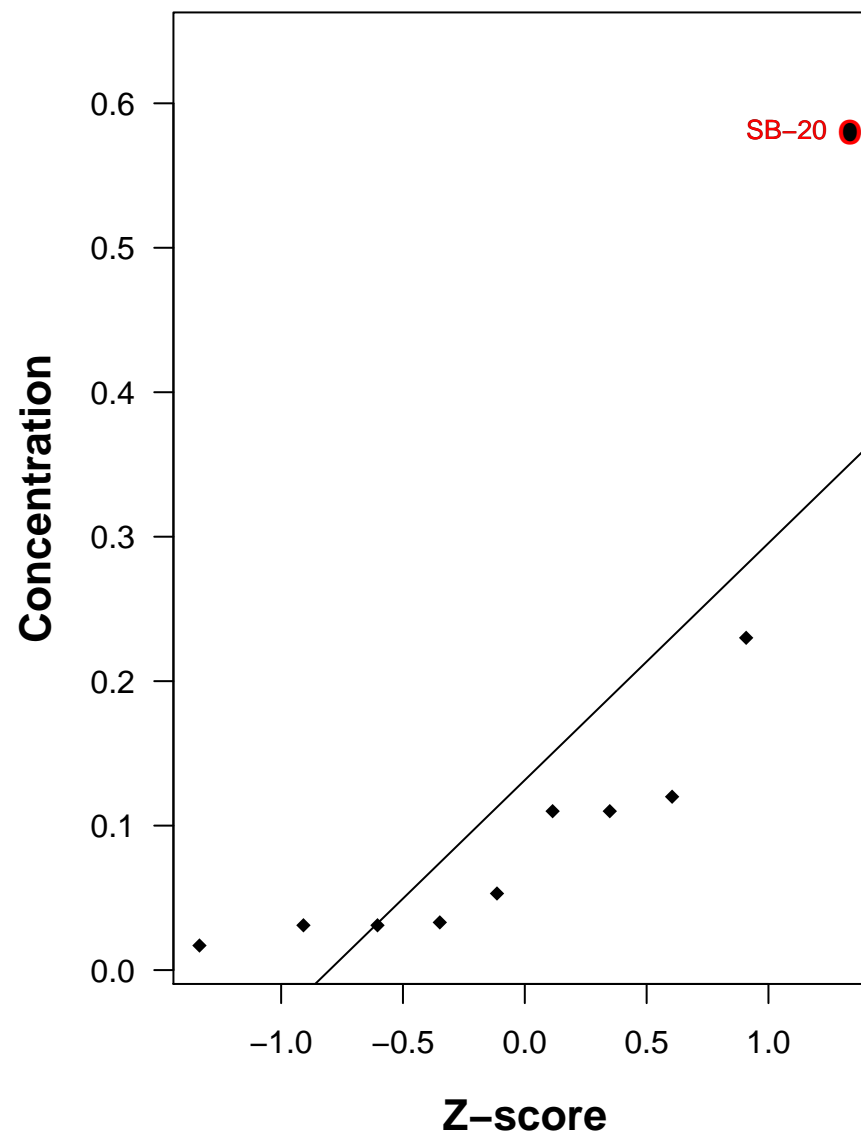
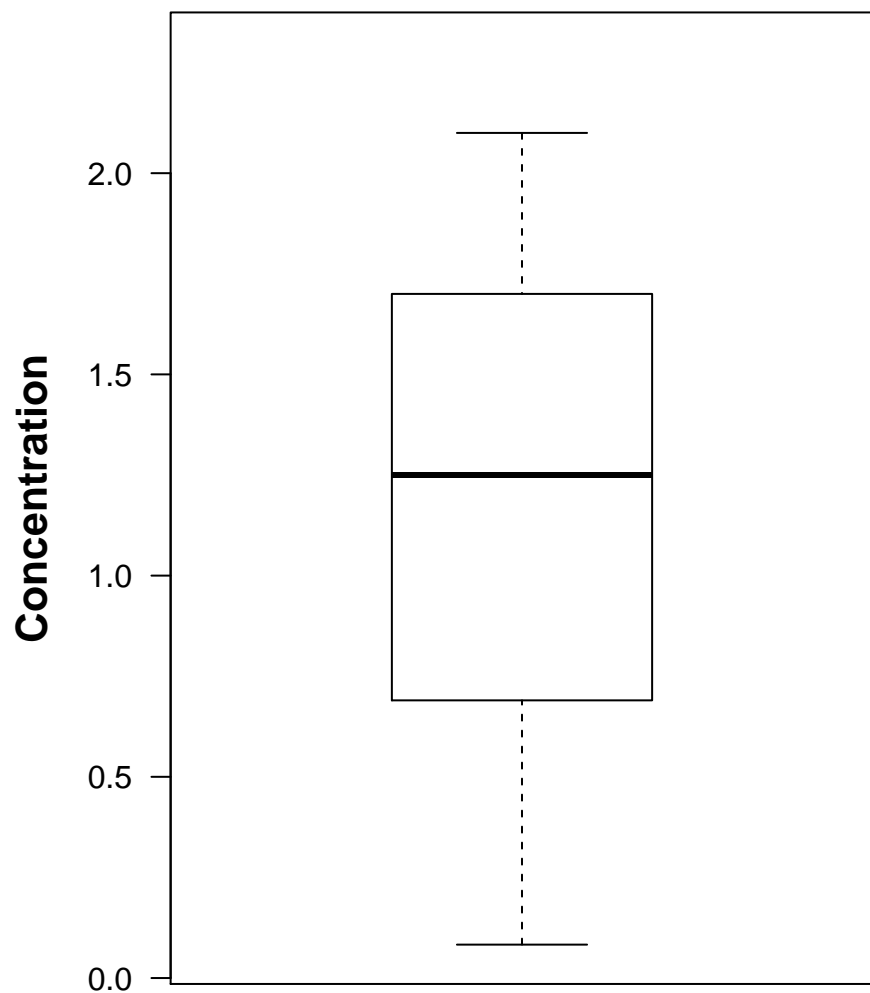


Figure B-47. SW8270, Benzo(b)fluoranthene (mg/Kg)

Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

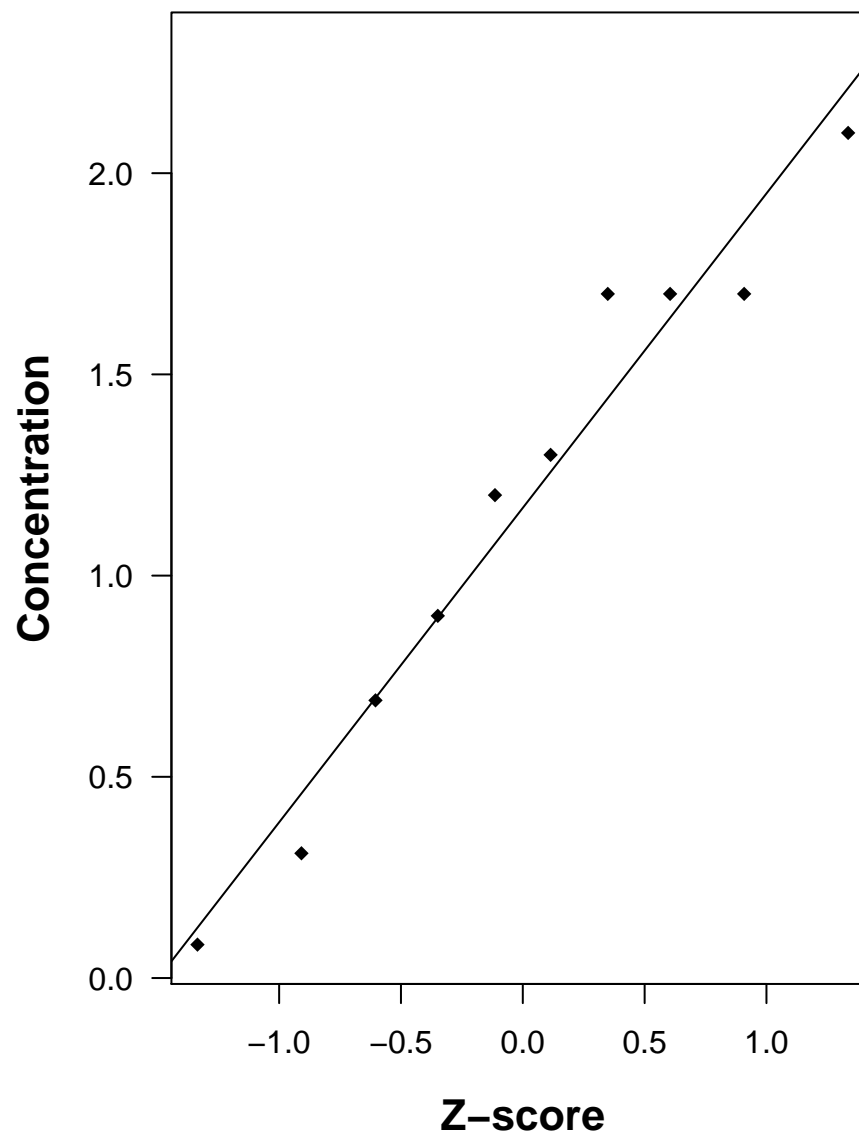
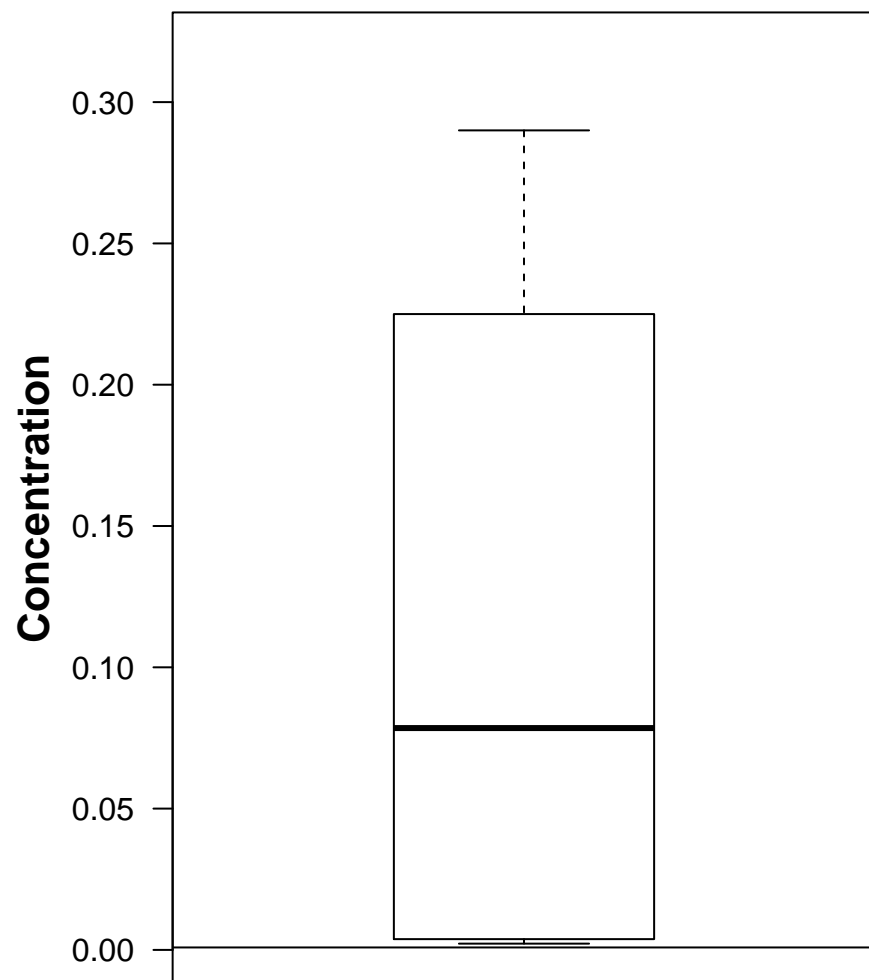


Figure B-48. SW8270, Benzo(g,h,i)perylene (mg/Kg)

No Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=15/20, Normal

Box Plot



Normal Probability Plot

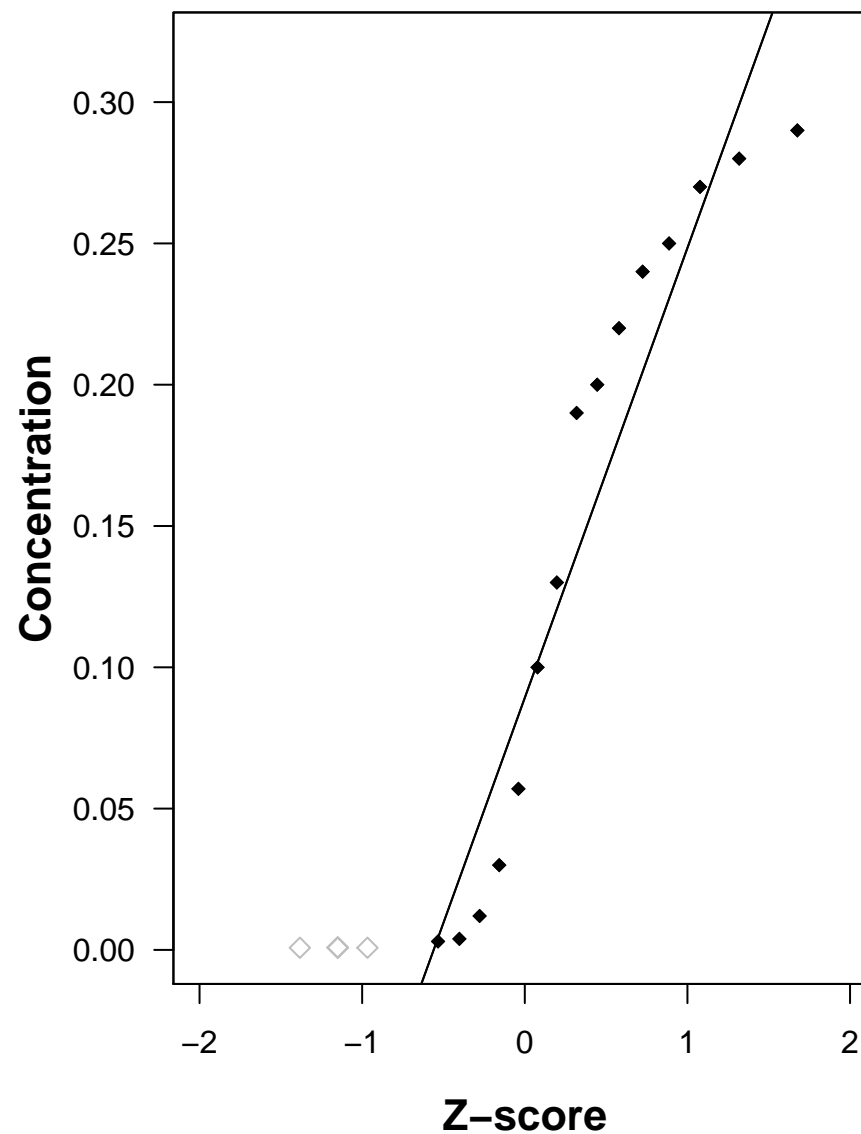
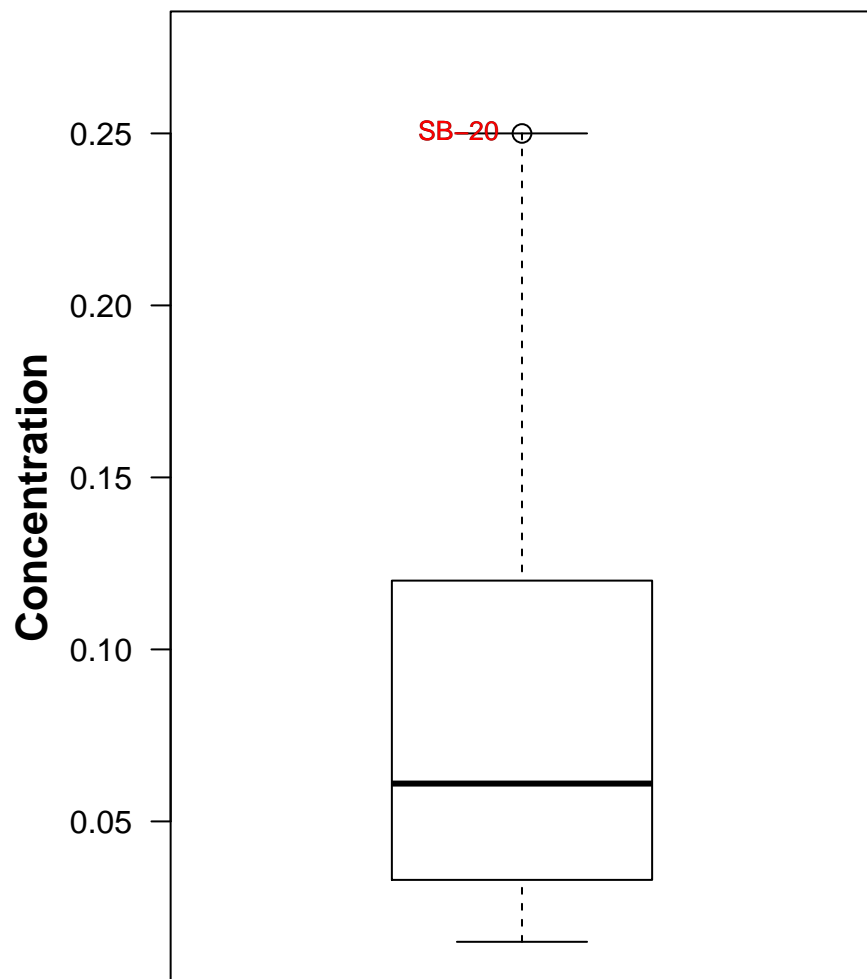


Figure B-49. SW8270, Benzo(g,h,i)perylene (mg/Kg)

Tidal Influence Shallow soil (1-2 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

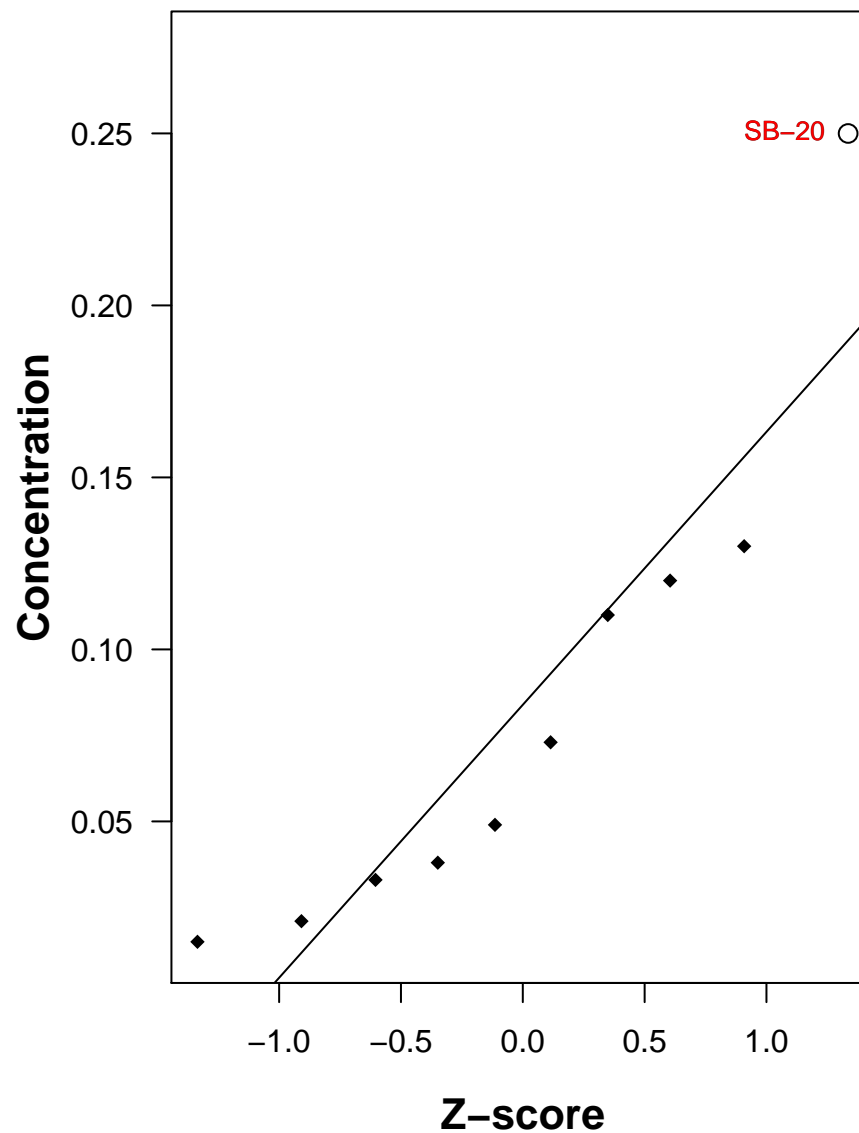
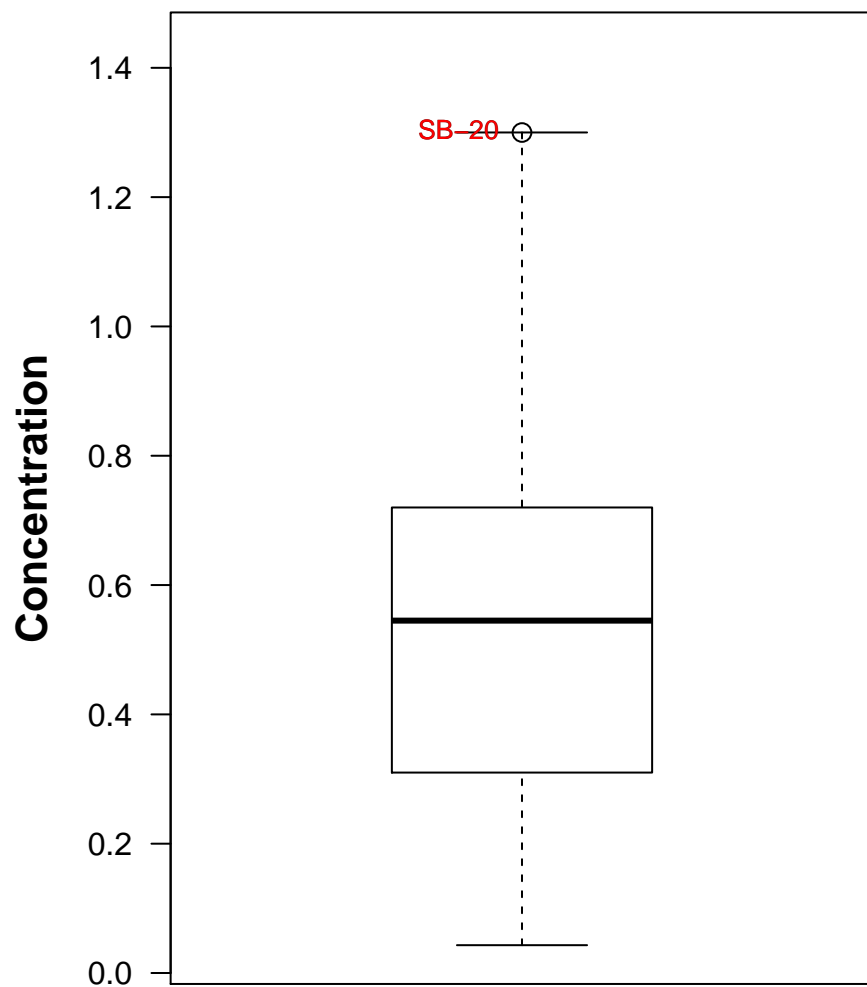


Figure B-50. SW8270, Benzo(g,h,i)perylene (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

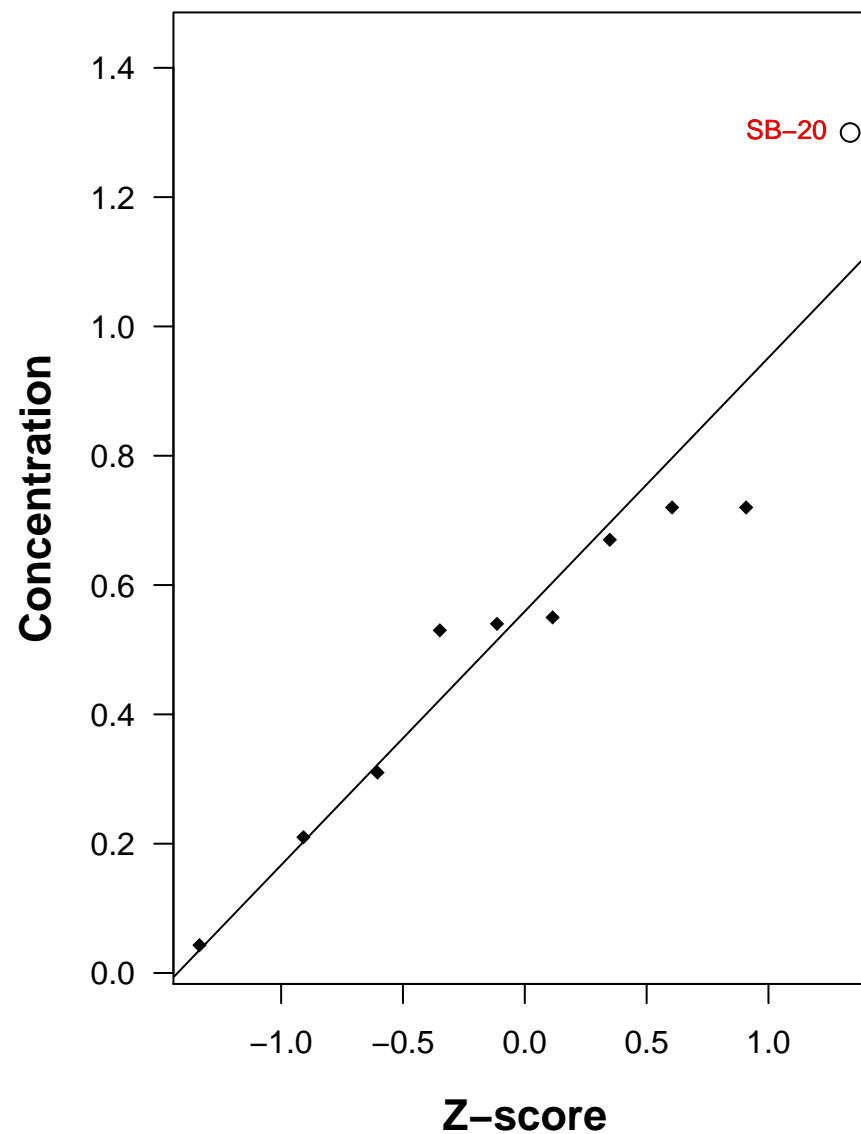
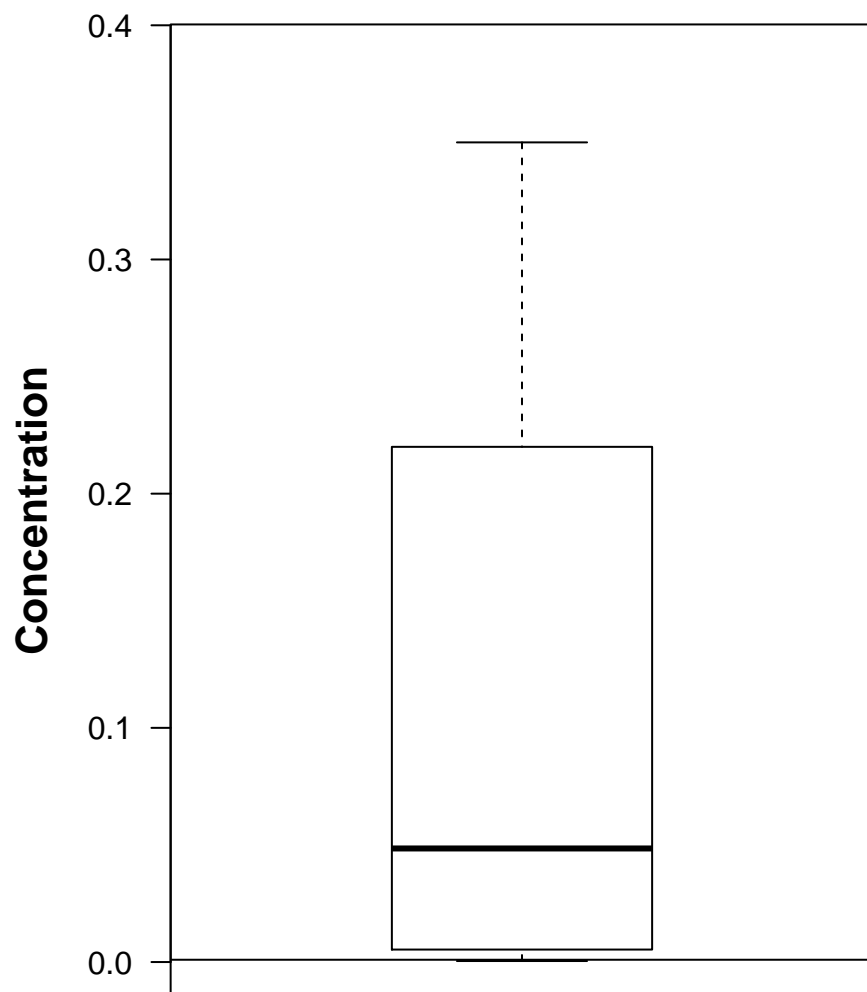


Figure B-51. SW8270, Benzo(k)fluoranthene (mg/Kg)

No Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=19/20, Gamma

Box Plot



Normal Probability Plot

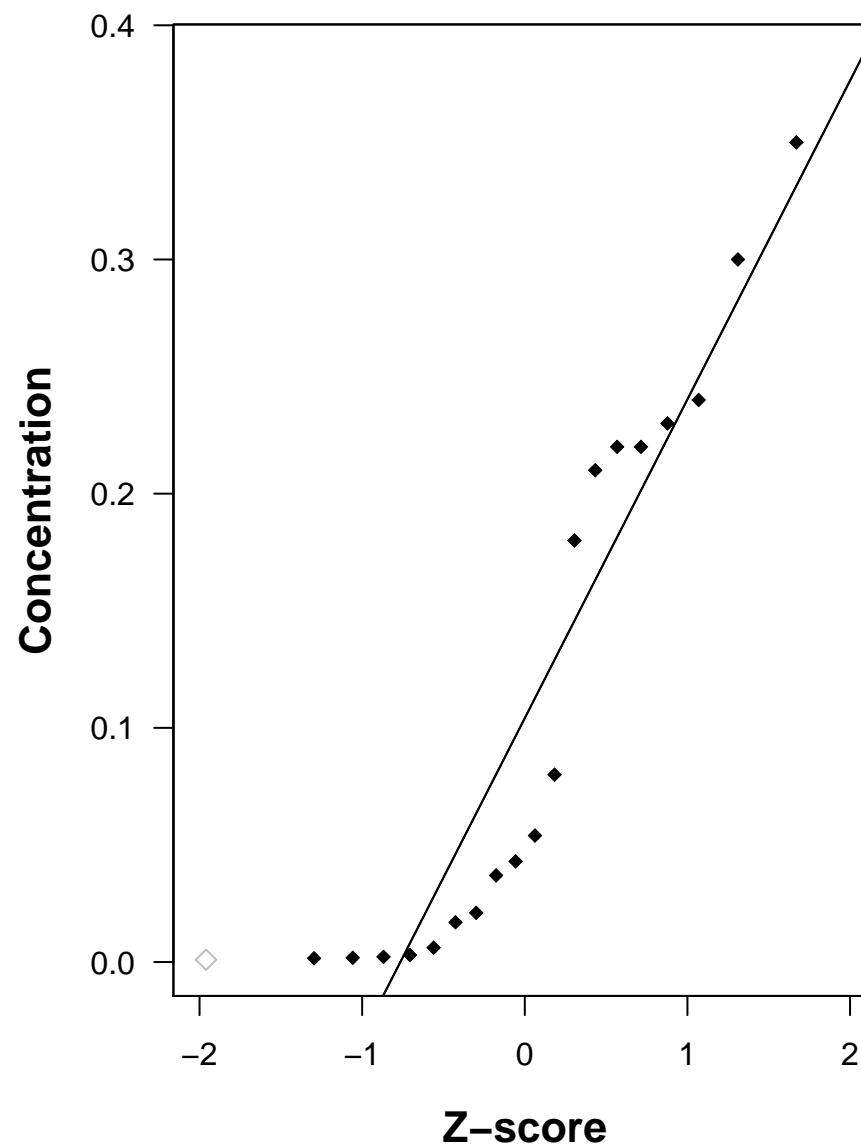
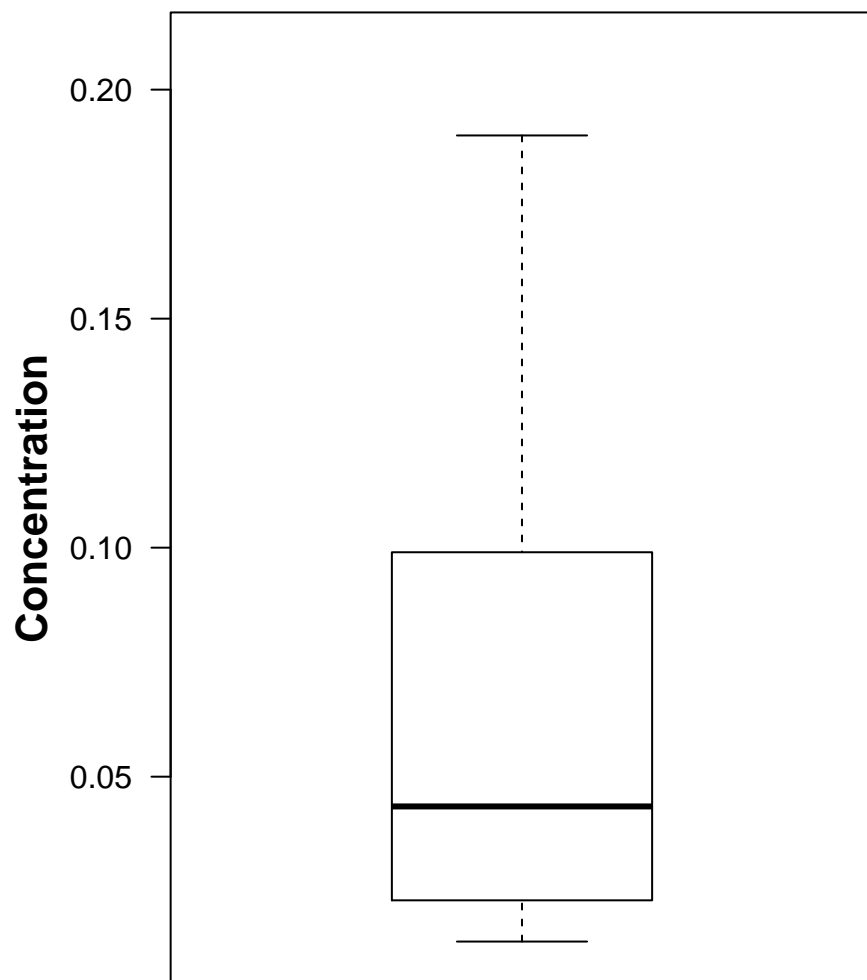


Figure B-52. SW8270, Benzo(k)fluoranthene (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

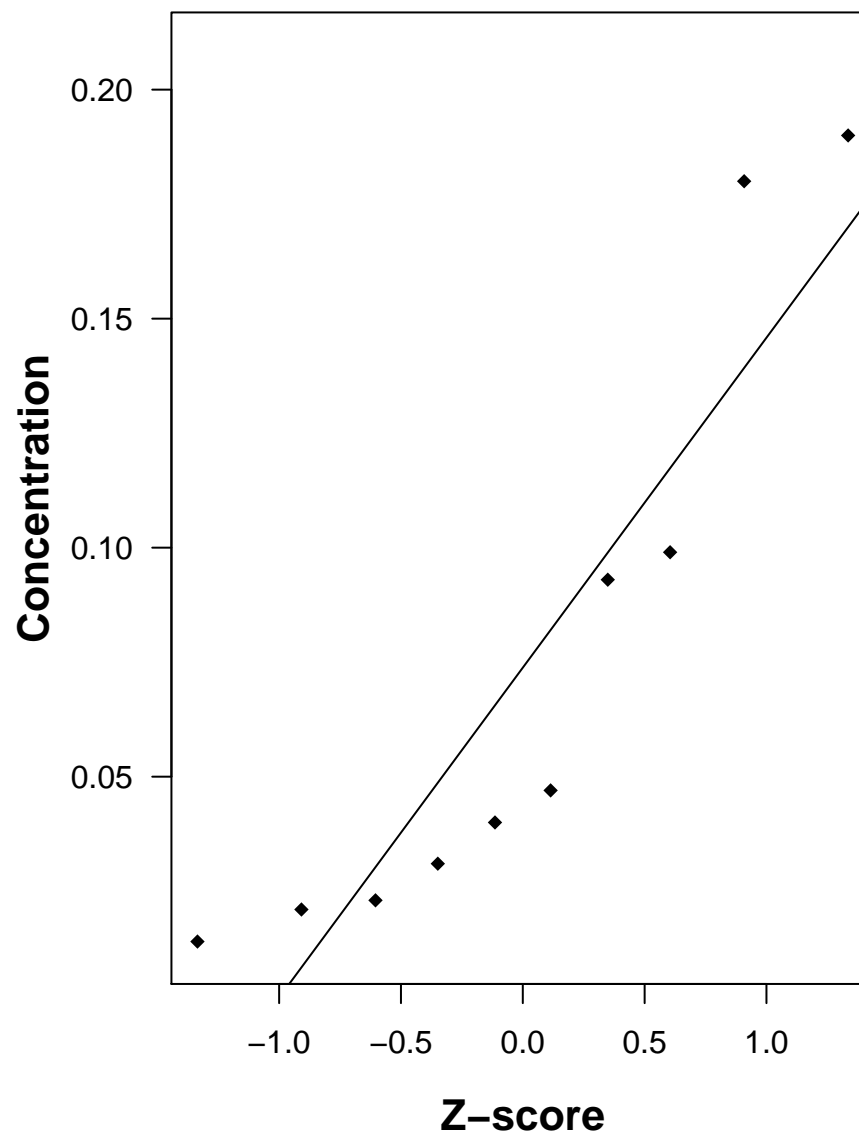
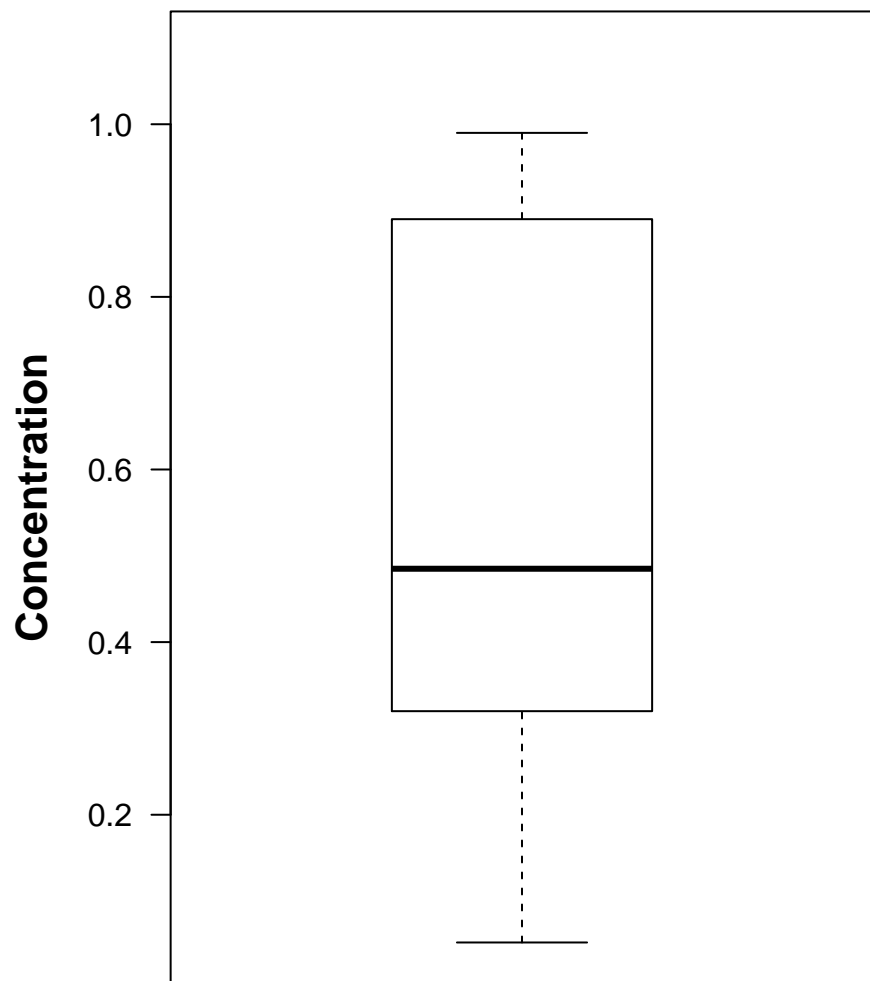


Figure B-53. SW8270, Benzo(k)fluoranthene (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

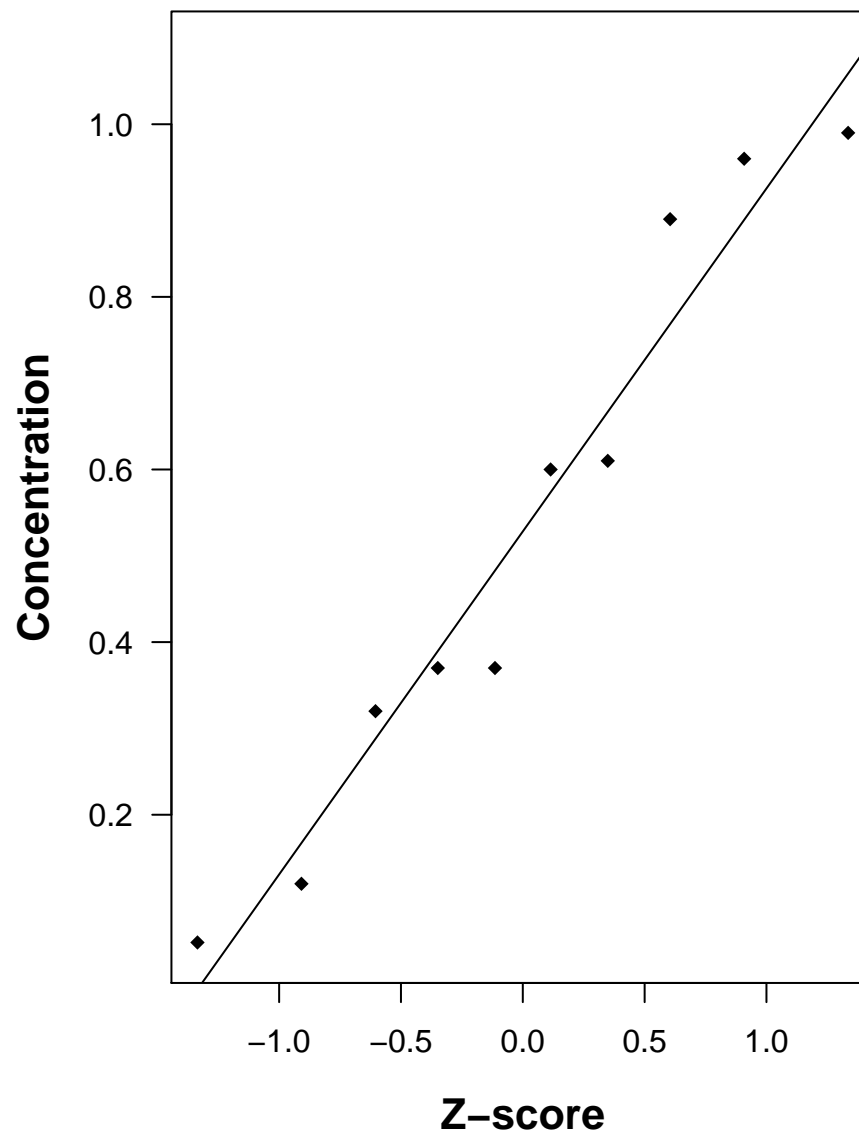
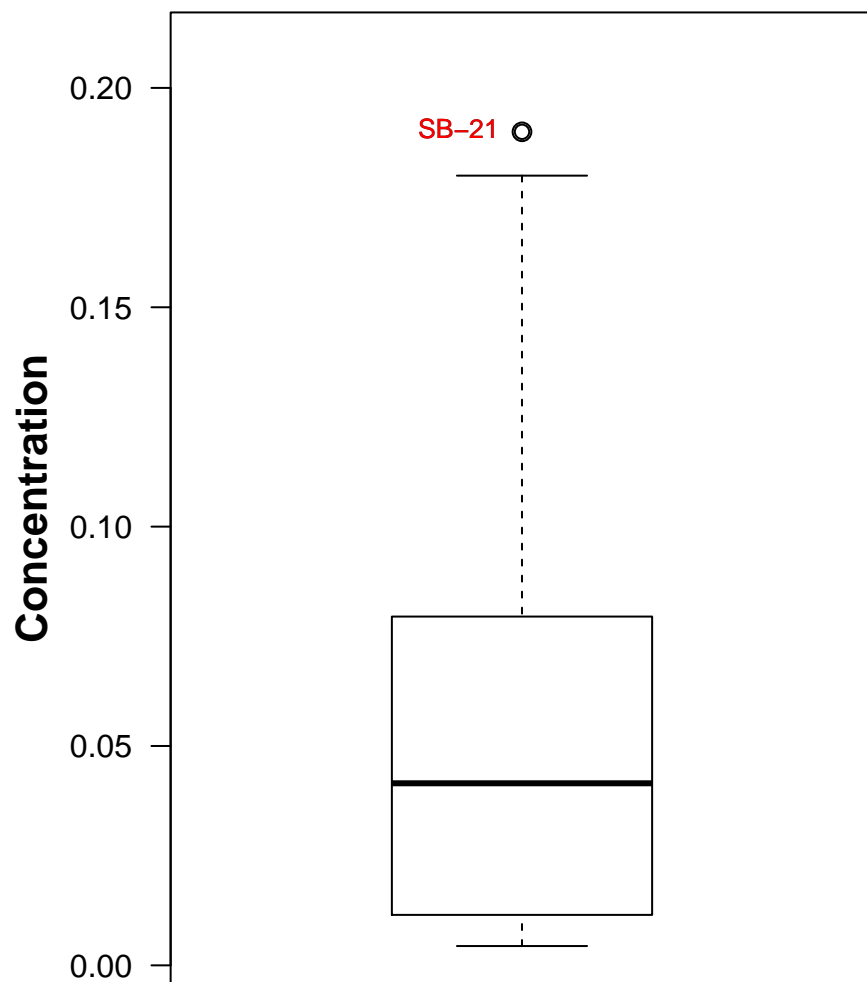


Figure B-54. SW8270, Bis(2-ethylhexyl)phthalate (mg/Kg)

No Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=20/20, Normal

Box Plot



Normal Probability Plot

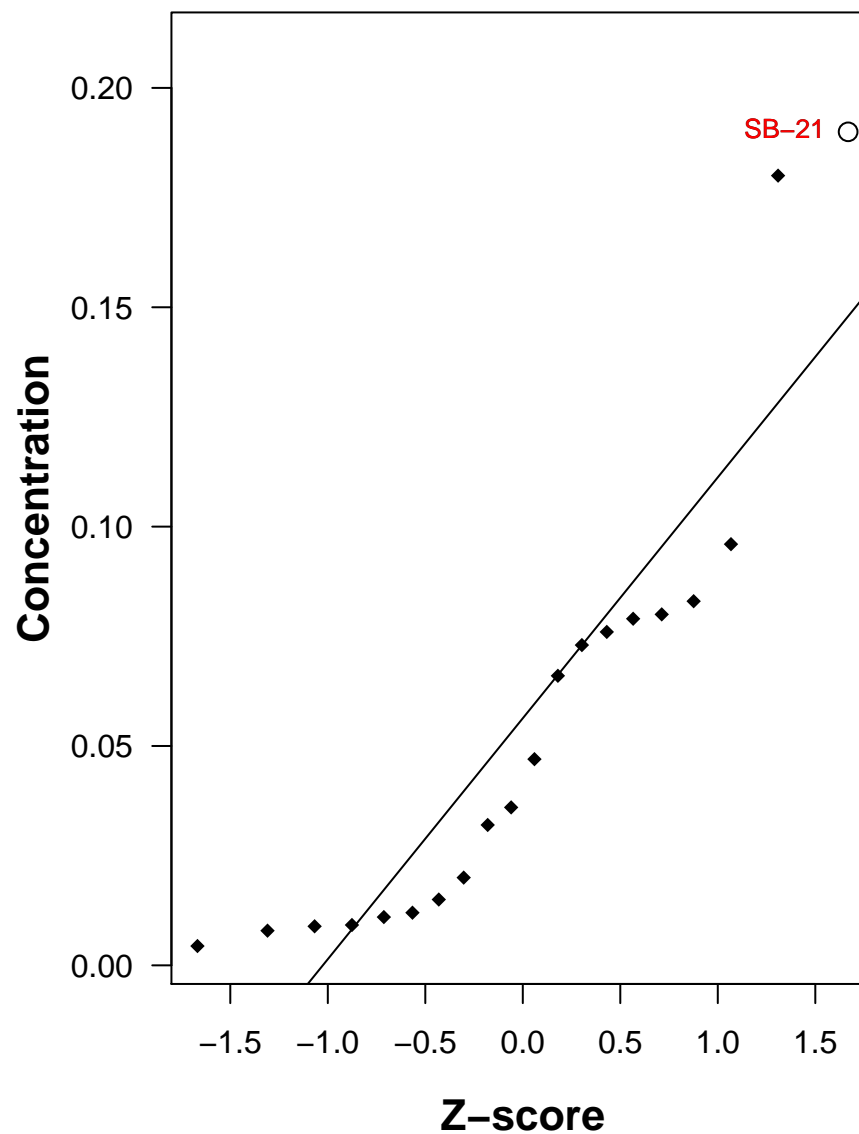
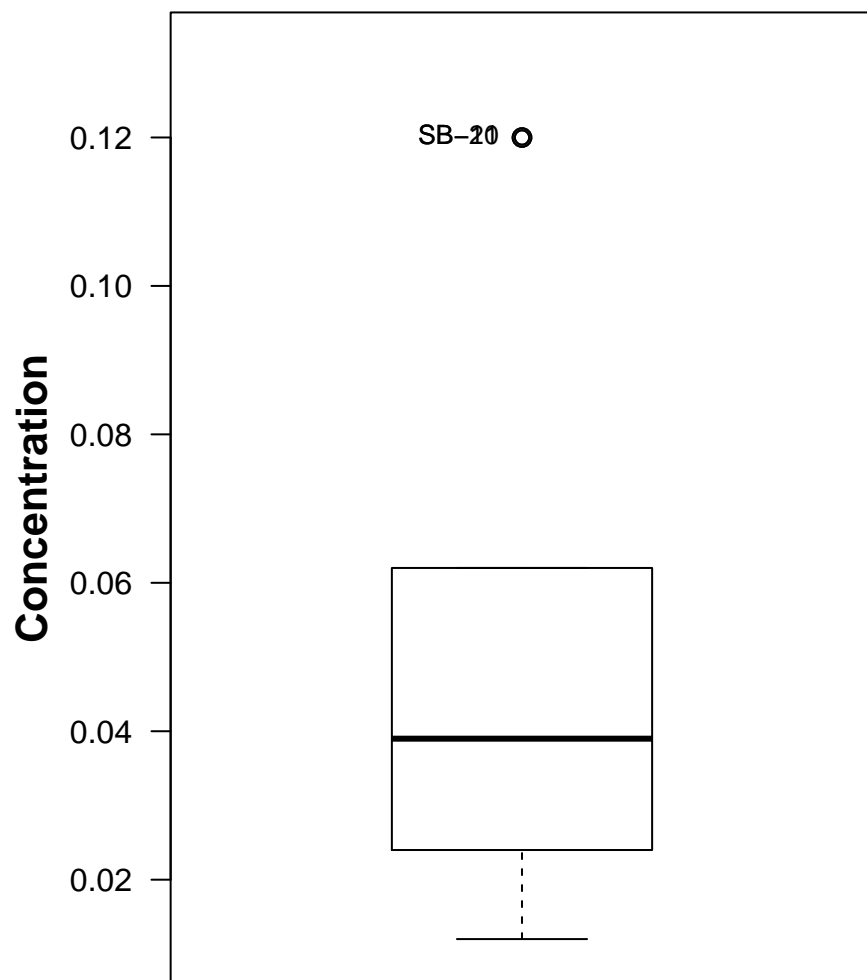


Figure B-55. SW8270, Bis(2-ethylhexyl)phthalate (mg/Kg)

Tidal Influence Shallow soil (1-2 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

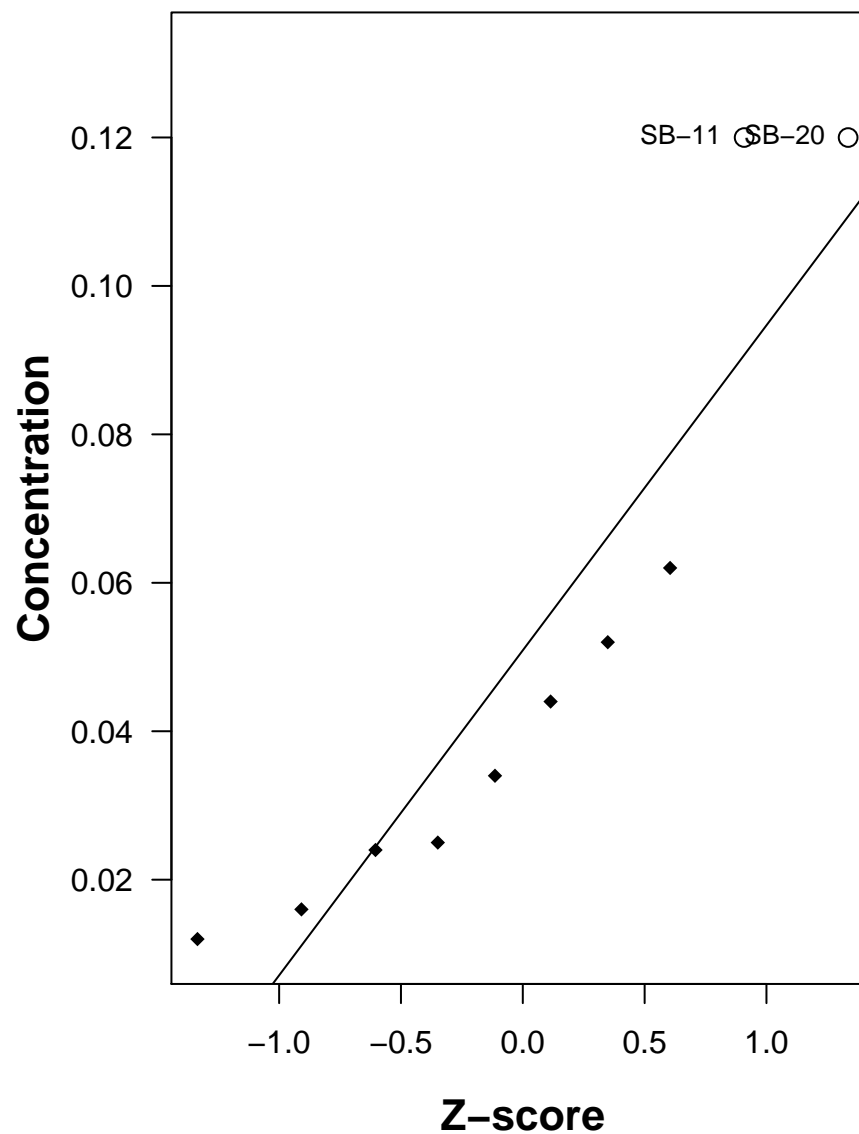
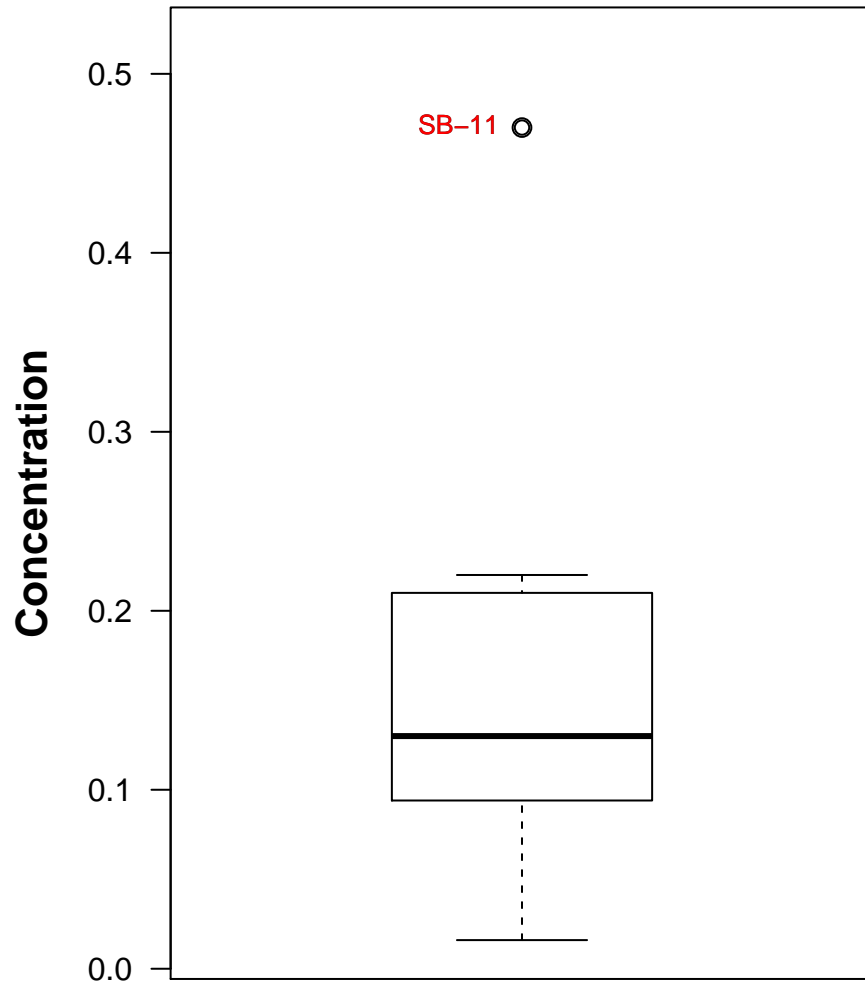


Figure B-56. SW8270, Bis(2-ethylhexyl)phthalate (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

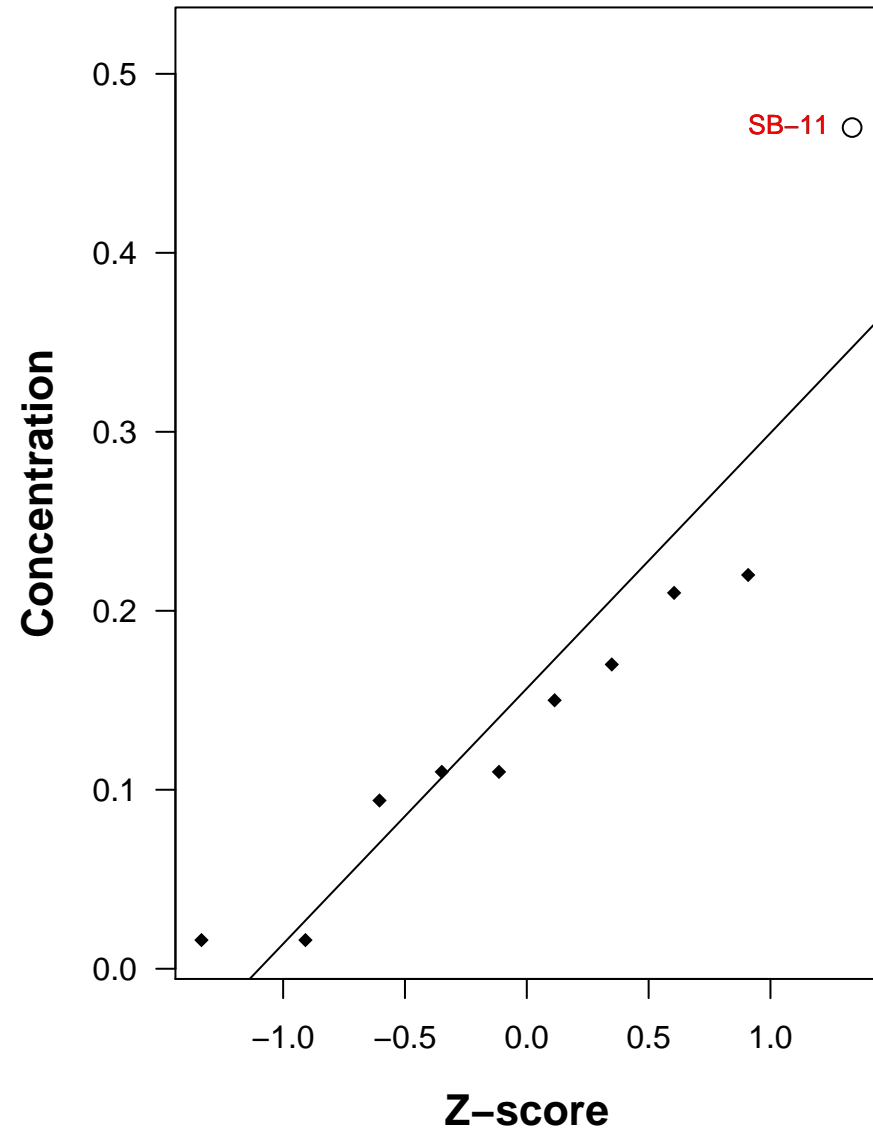
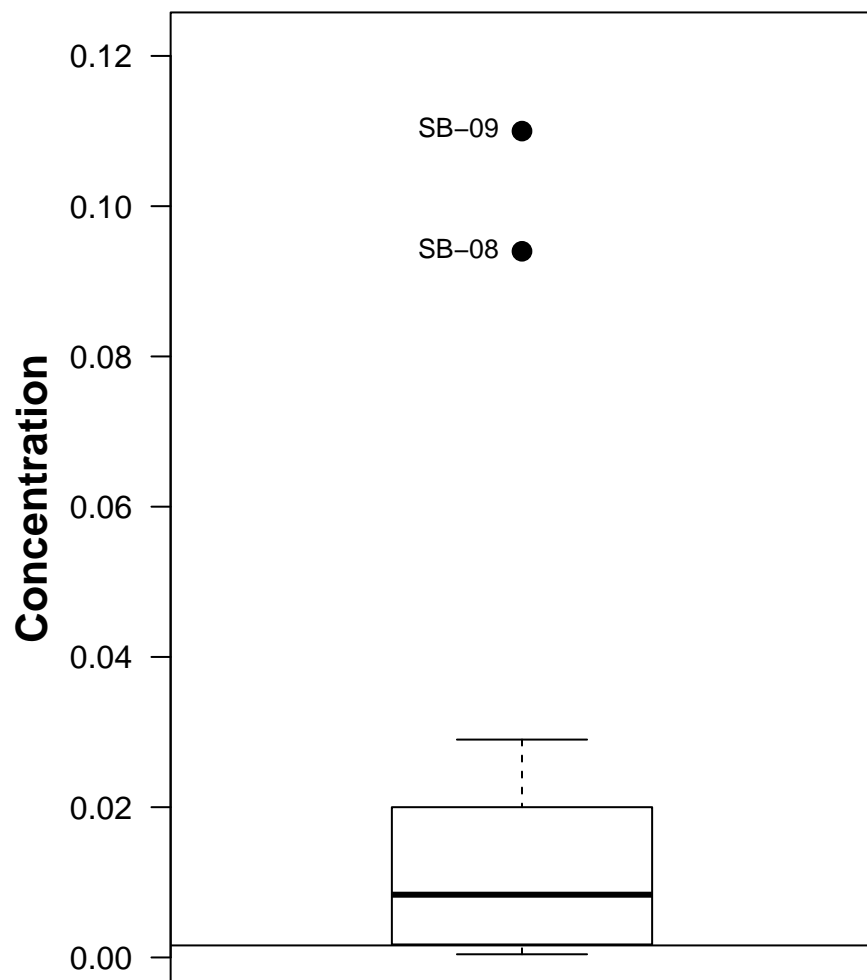


Figure B-57. SW8270, Butyl benzyl phthalate (mg/Kg)

No Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=14/20, Lognormal

Box Plot



Normal Probability Plot

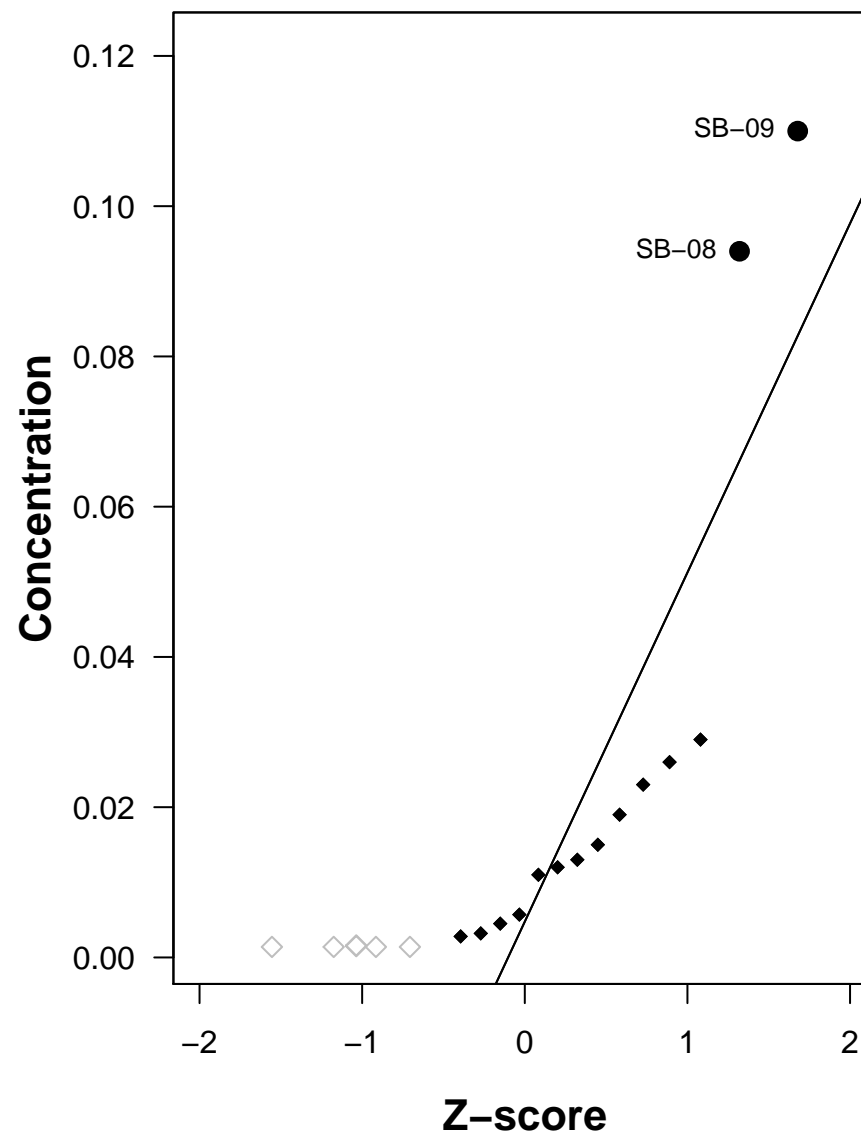
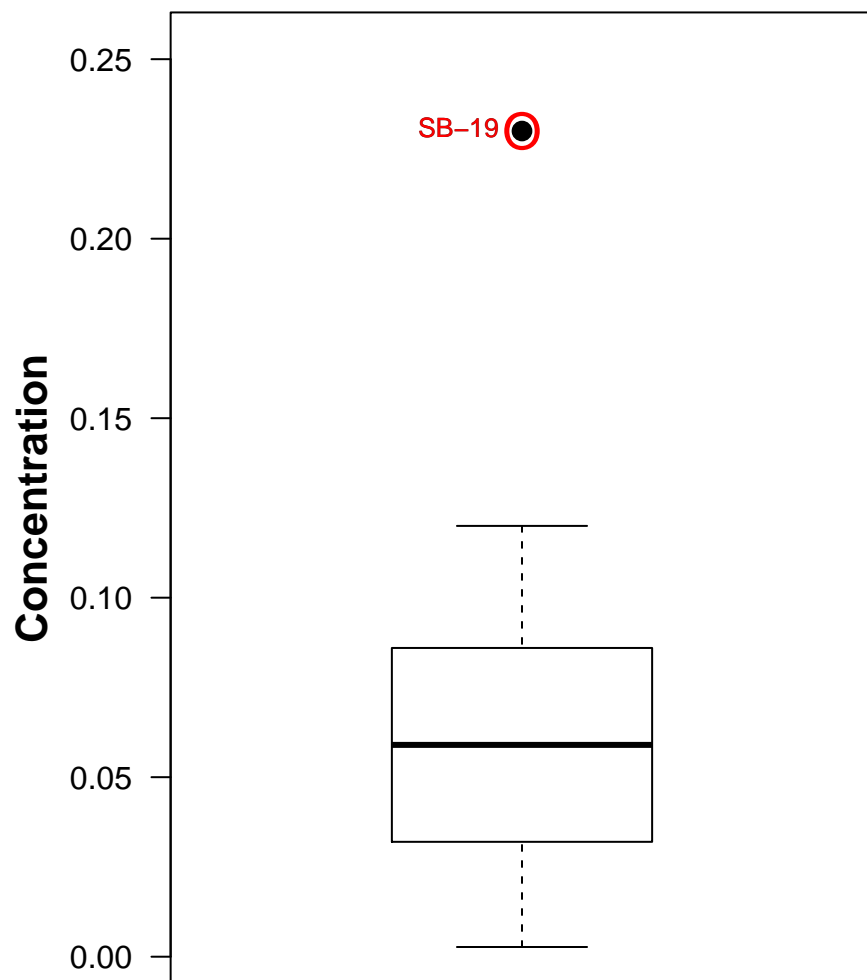


Figure B-58. SW8270, Butyl benzyl phthalate (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

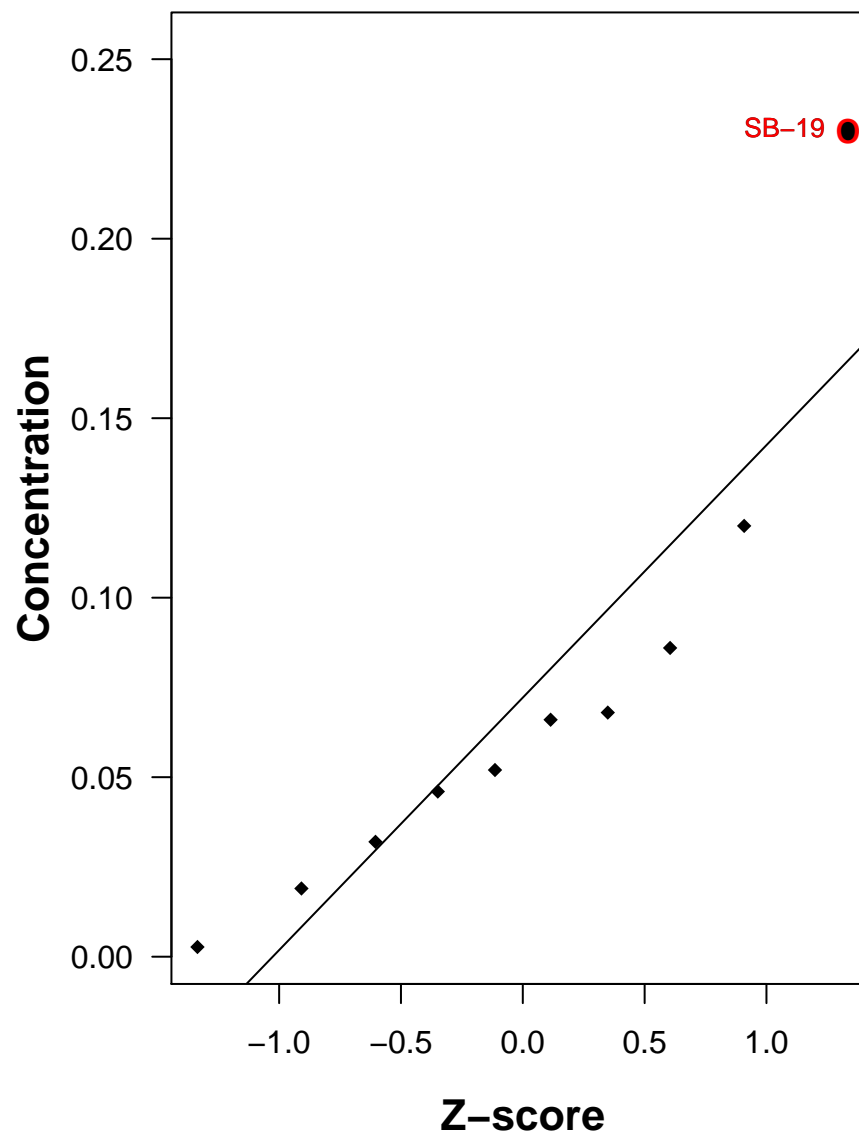
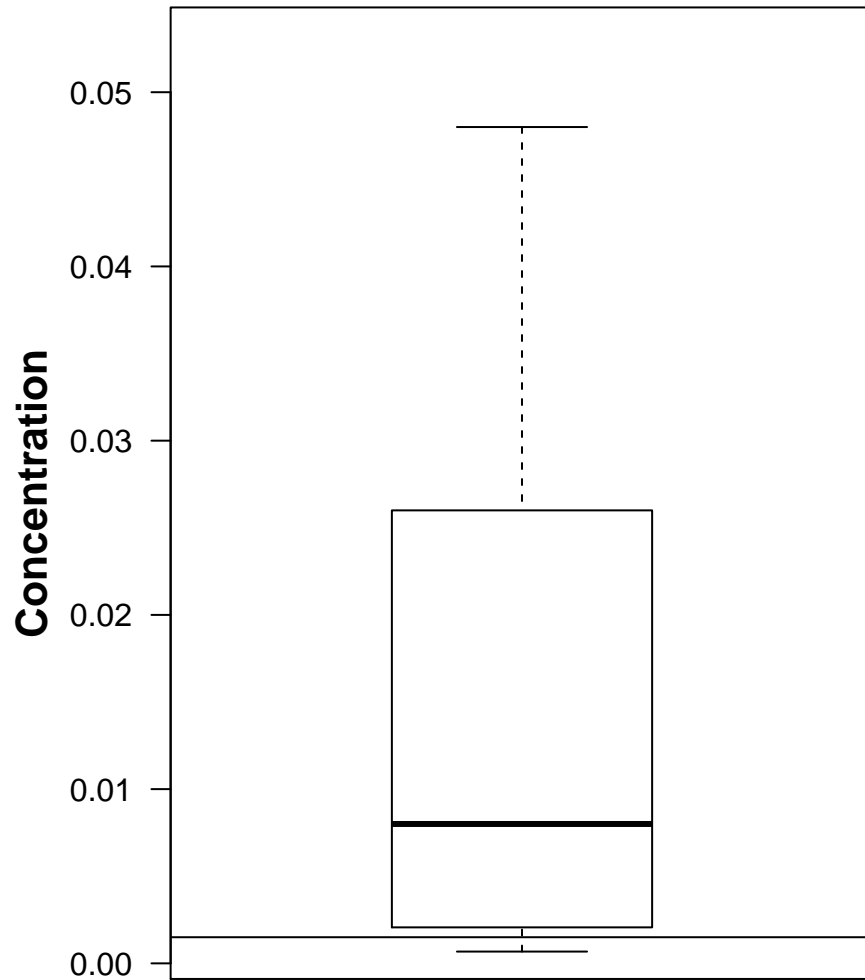


Figure B-59. SW8270, Carbazole (mg/Kg)

No Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=13/20, Normal

Box Plot



Normal Probability Plot

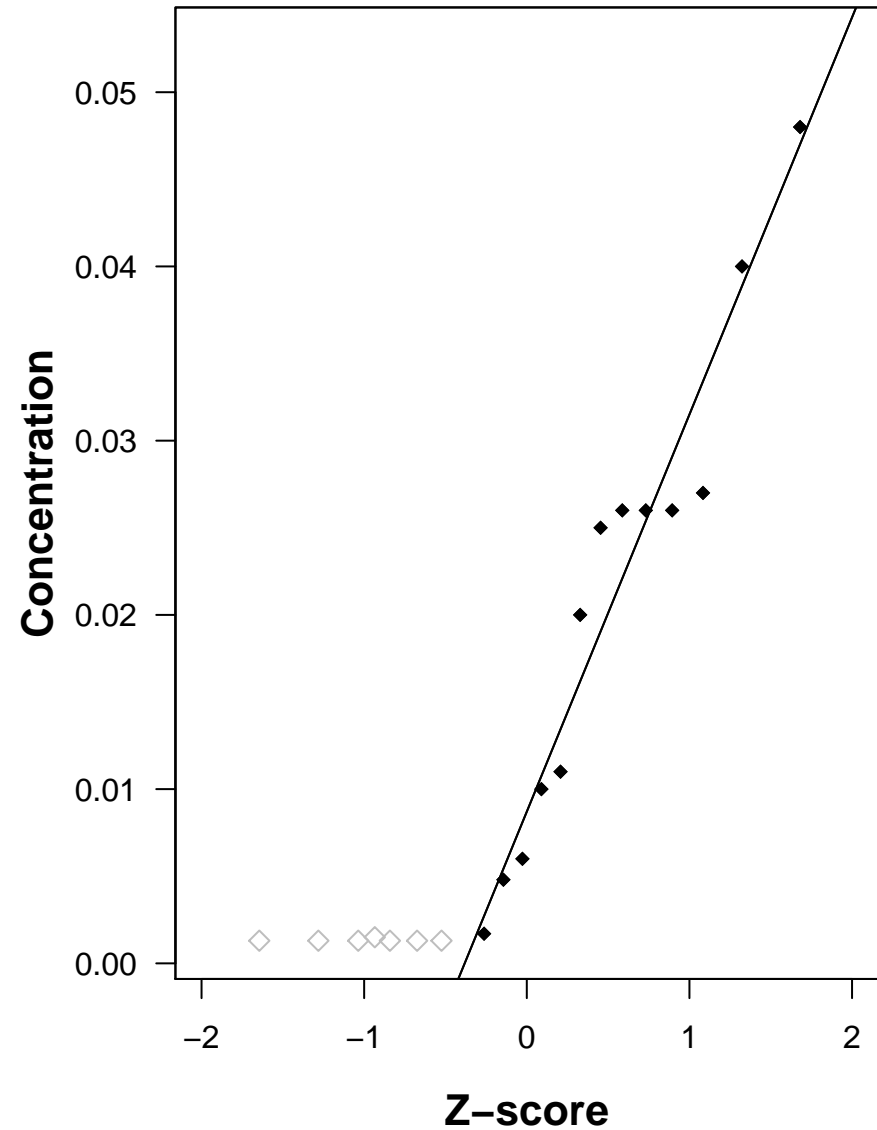
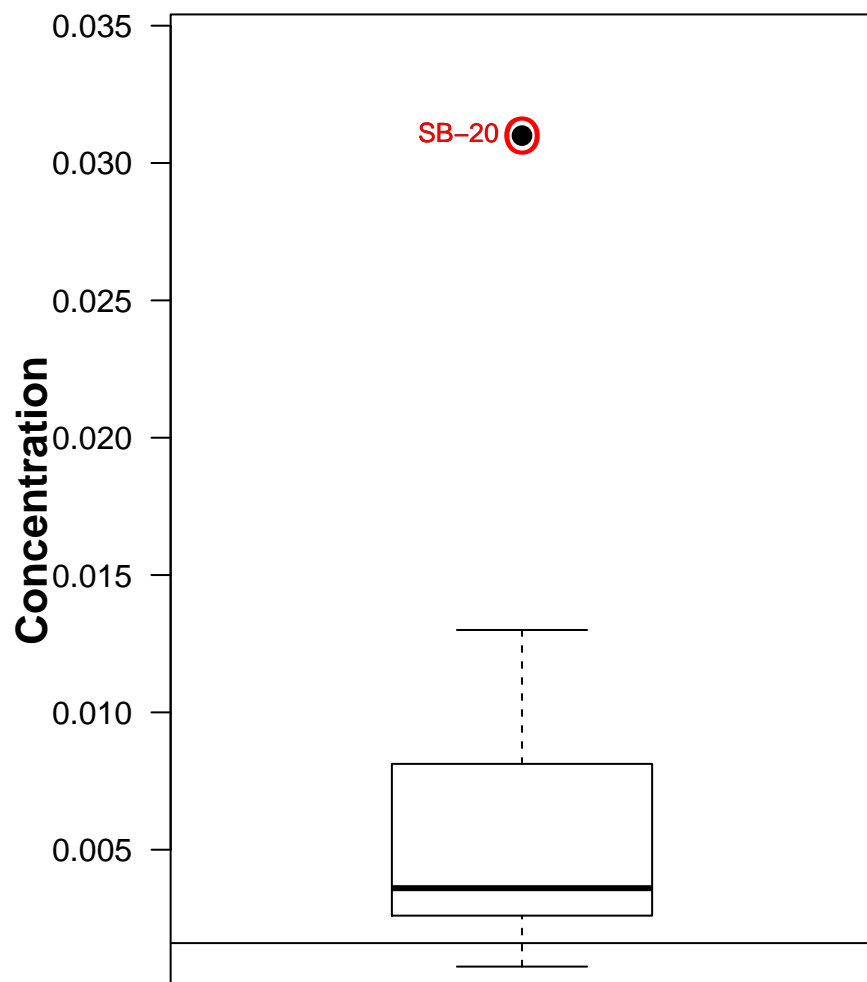


Figure B-60. SW8270, Carbazole (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=8/10, Normal

Box Plot



Normal Probability Plot

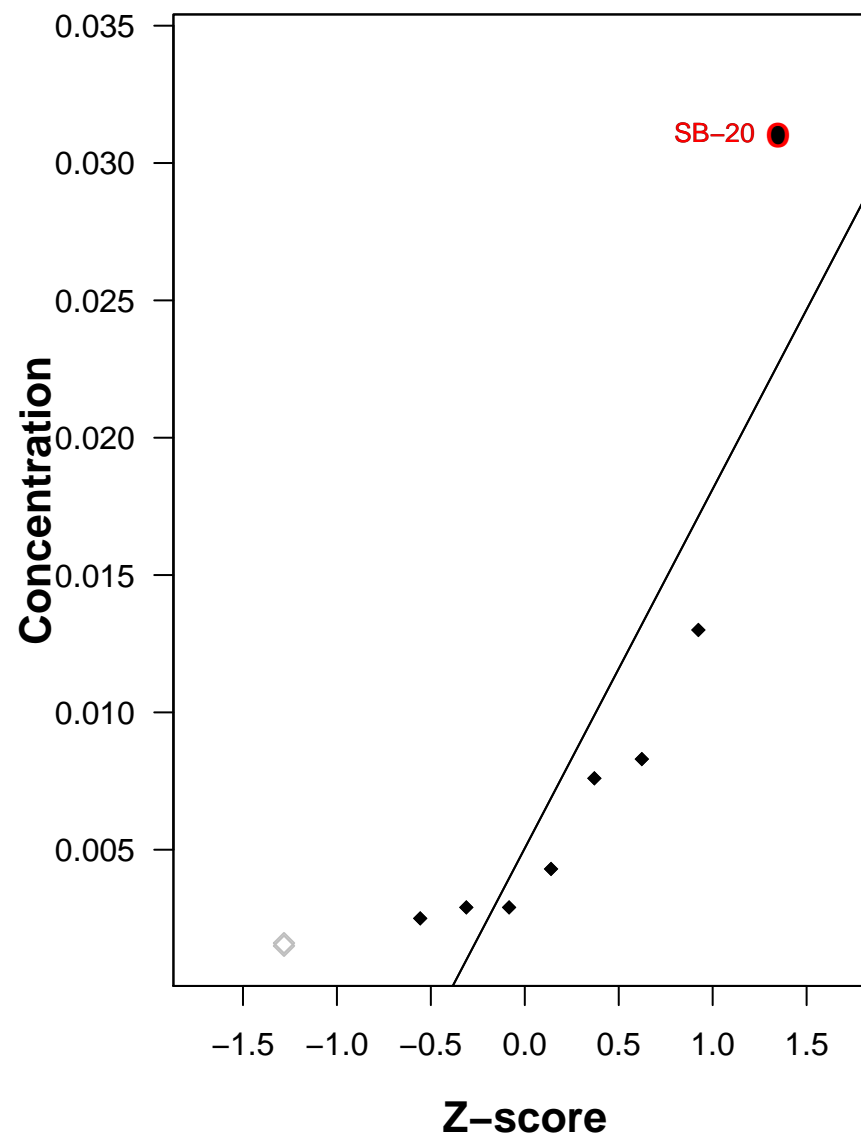
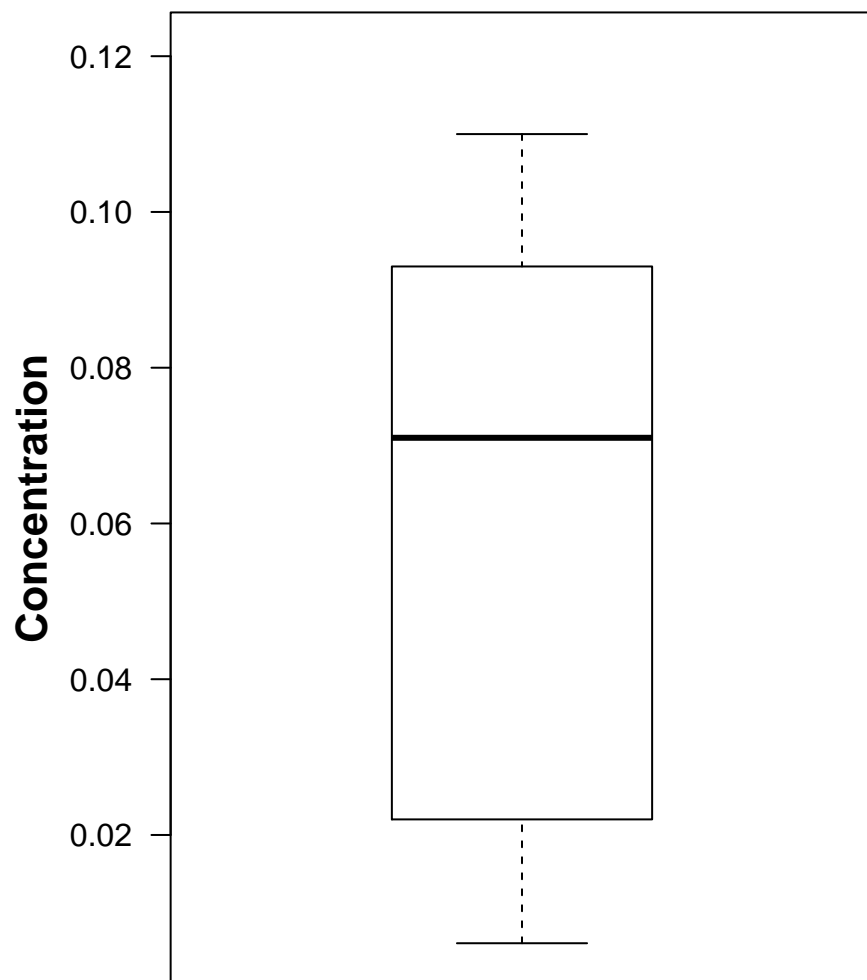


Figure B-61. SW8270, Carbazole (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

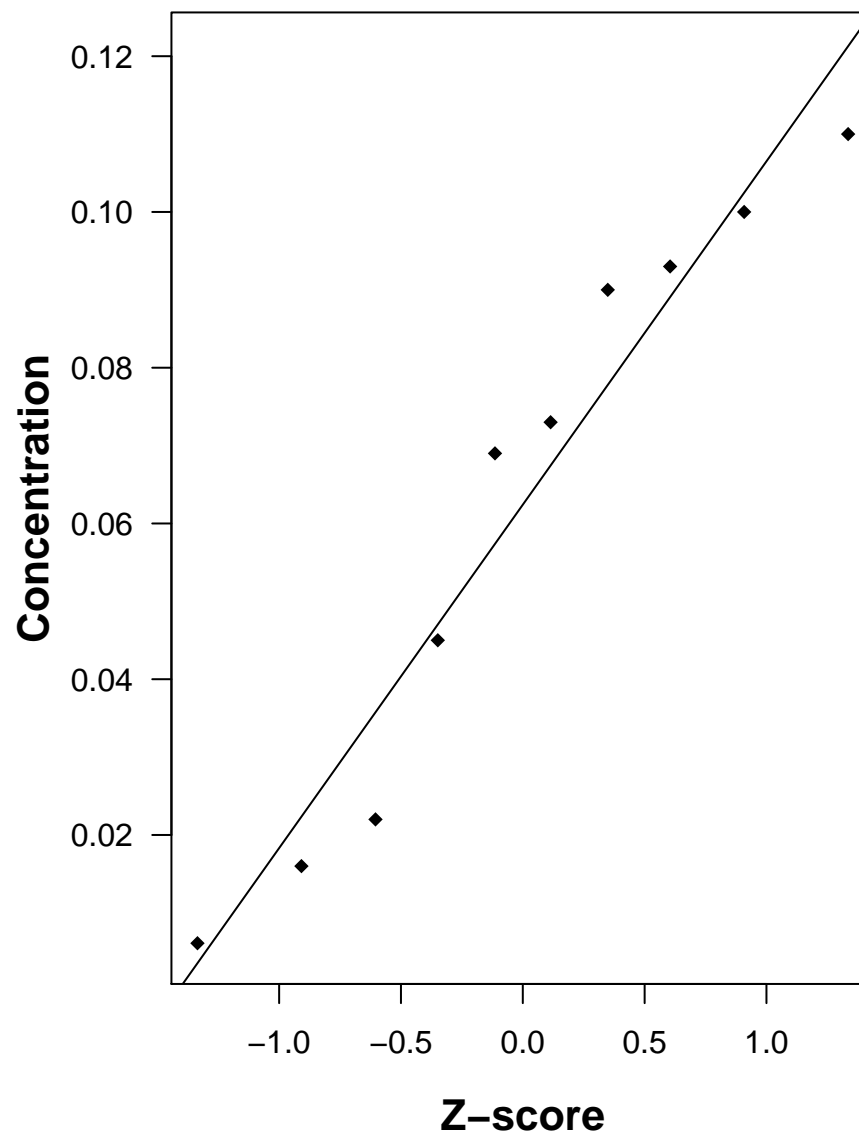
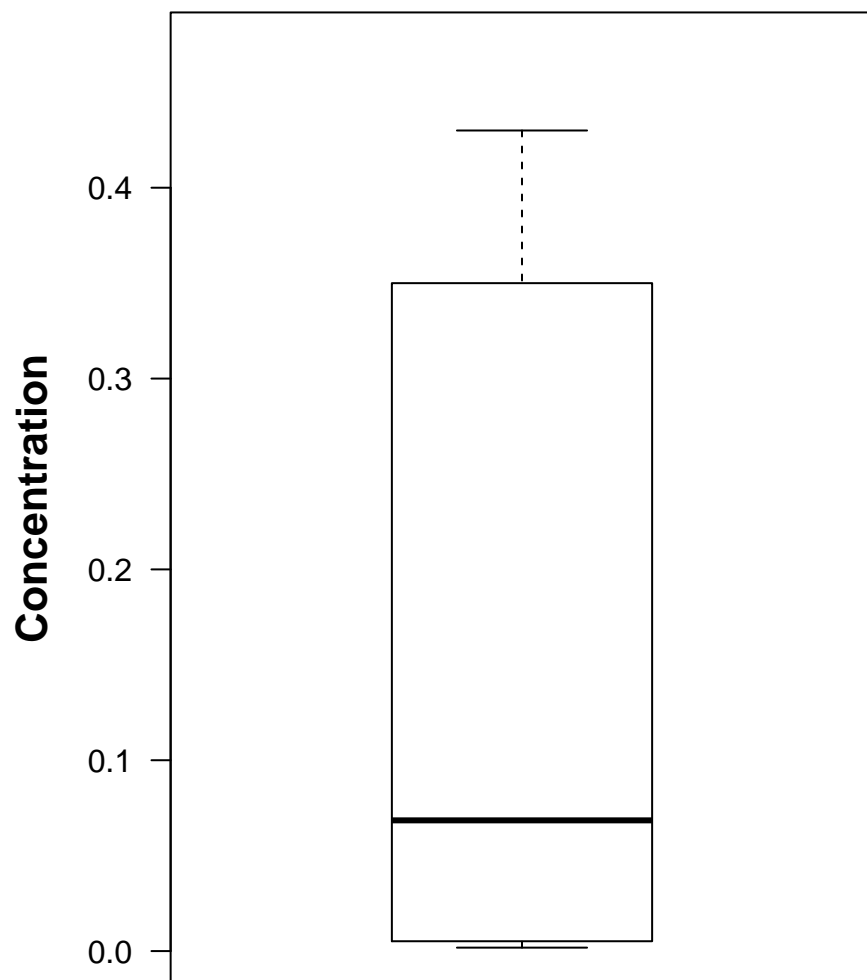


Figure B-62. SW8270, Chrysene (mg/Kg)

No Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=20/20, Gamma

Box Plot



Normal Probability Plot

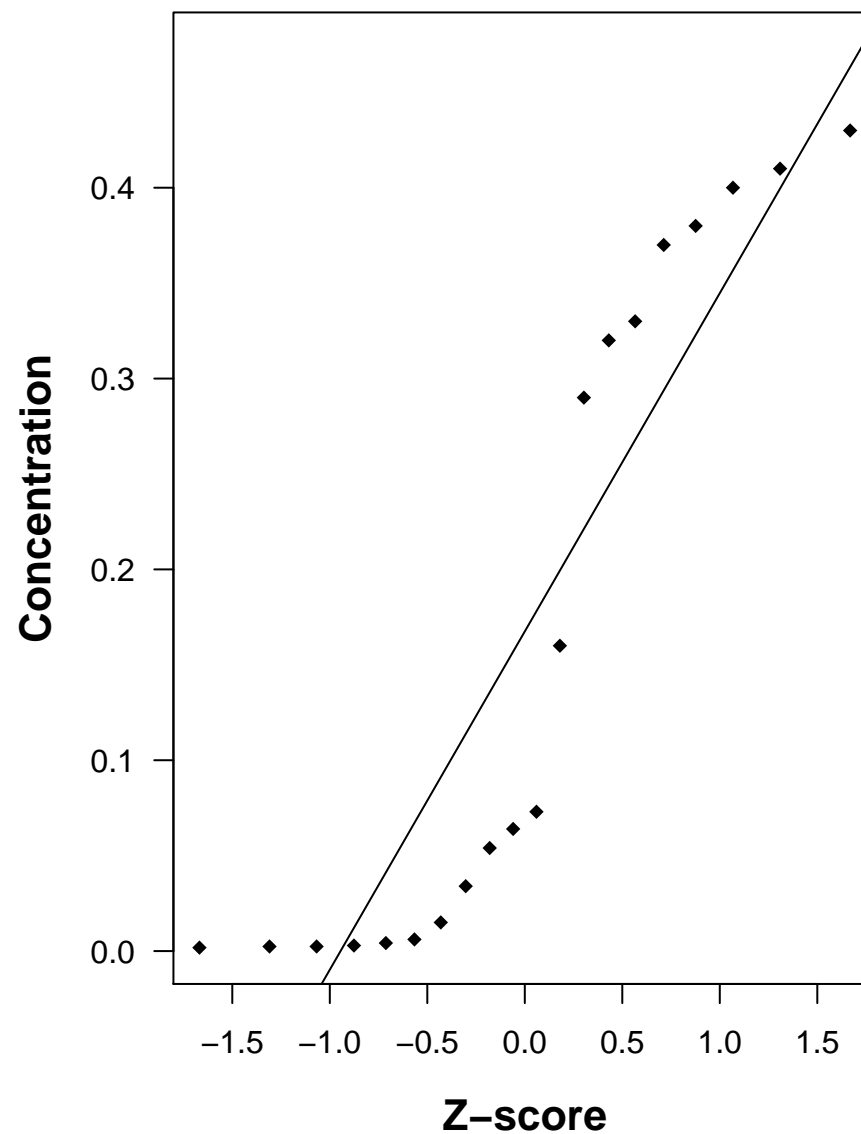
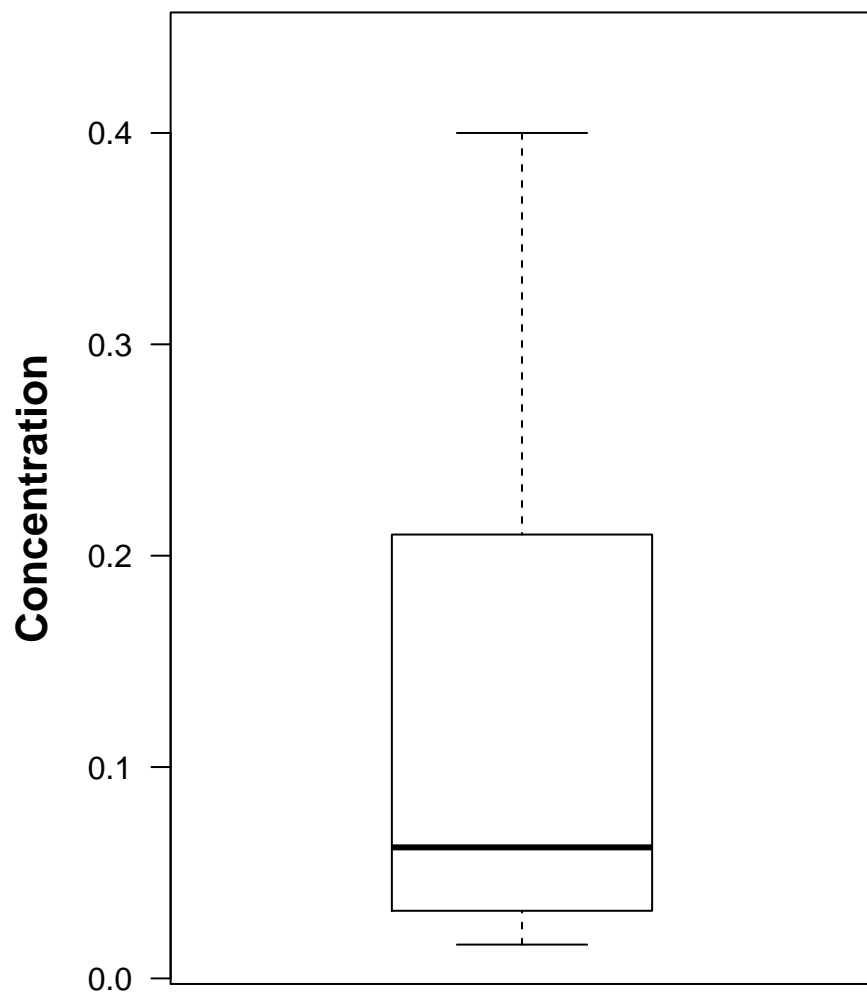


Figure B-63. SW8270, Chrysene (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

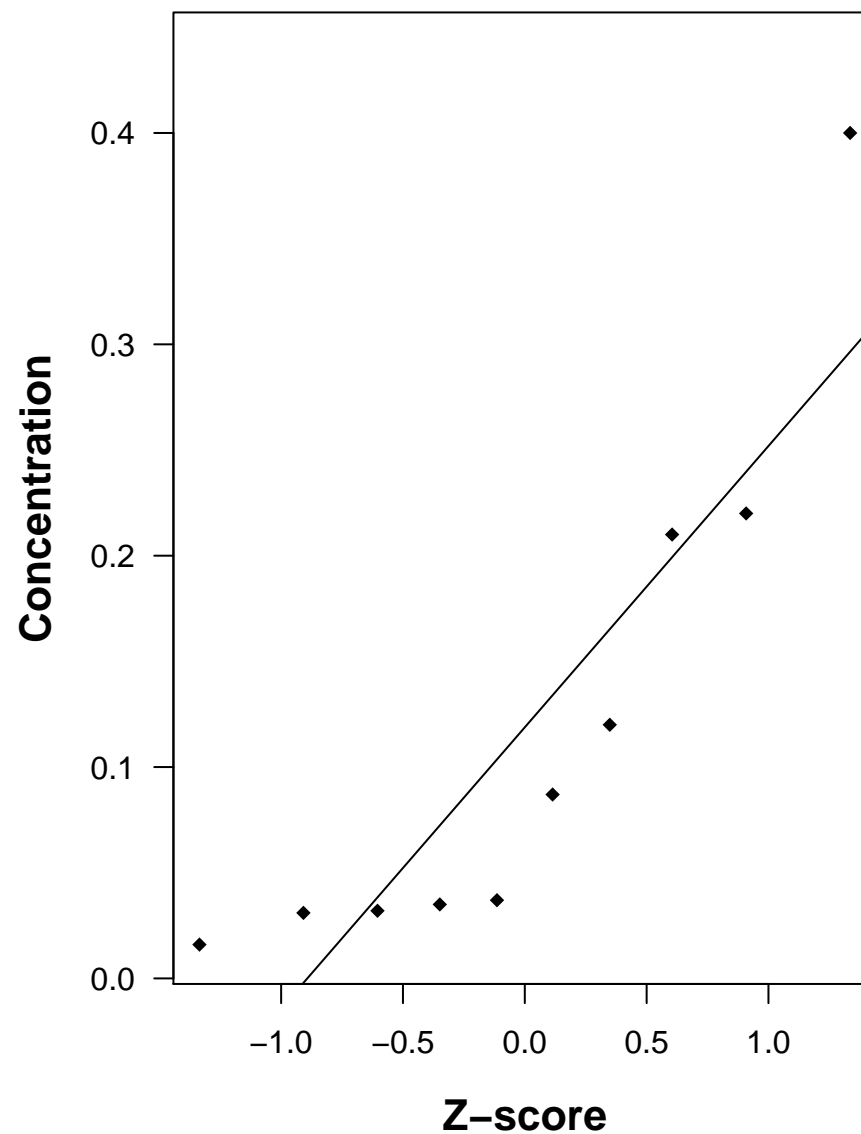
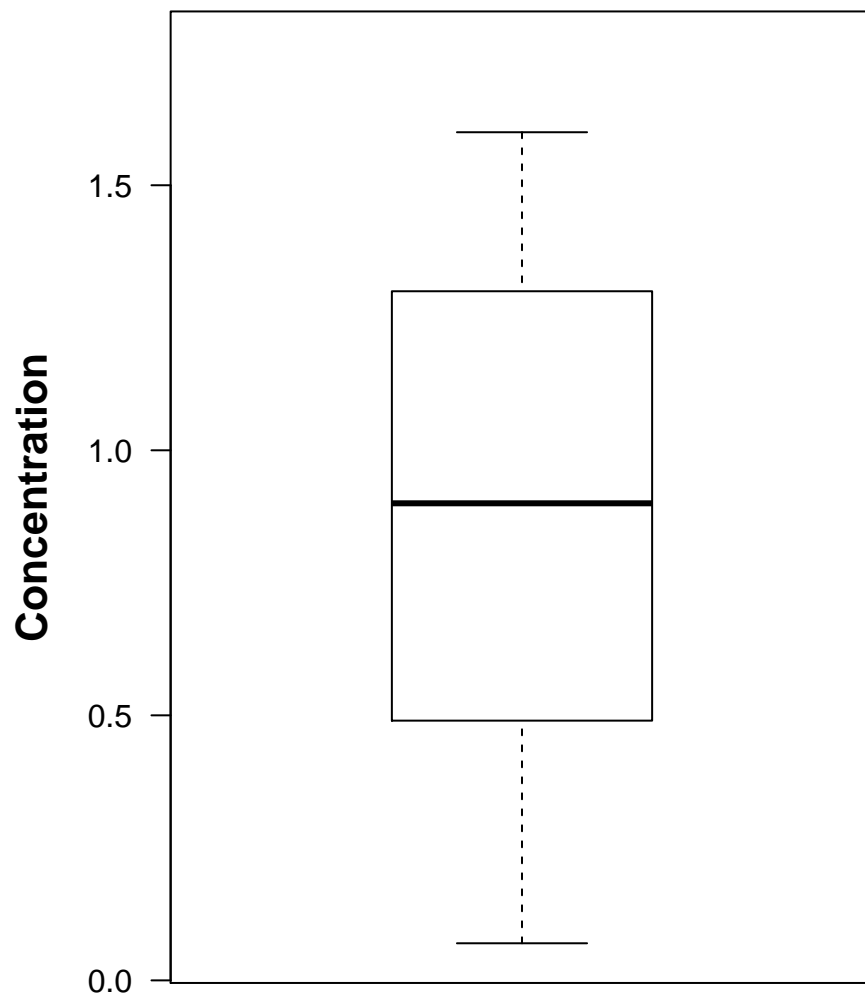


Figure B-64. SW8270, Chrysene (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

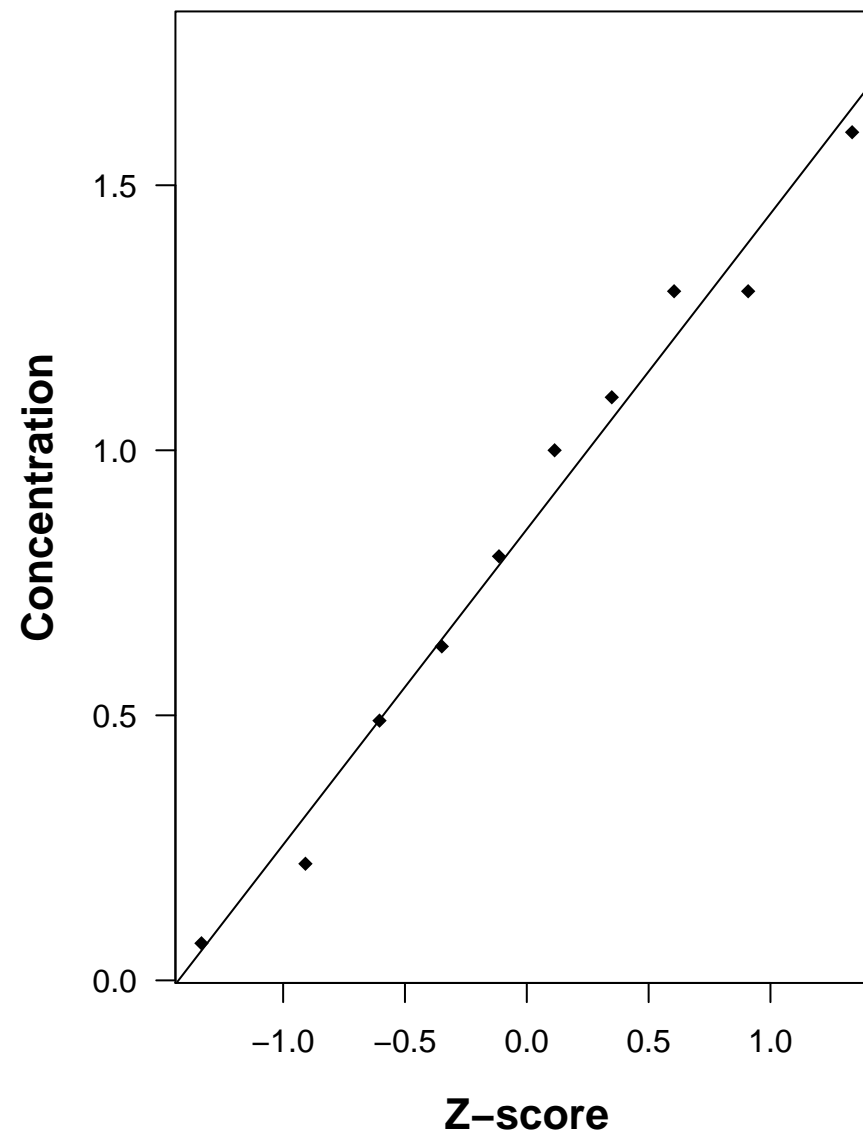
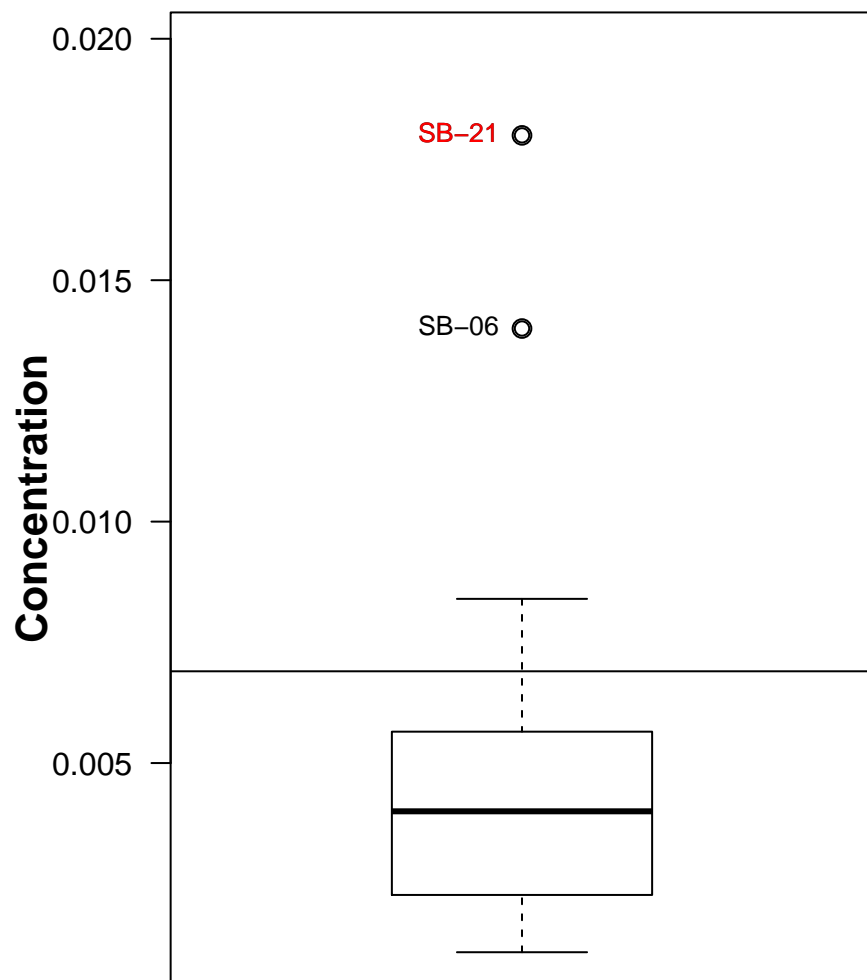


Figure B-65. SW8270, Di-n-butyl phthalate (mg/Kg)

No Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=14/20, Lognormal

Box Plot



Normal Probability Plot

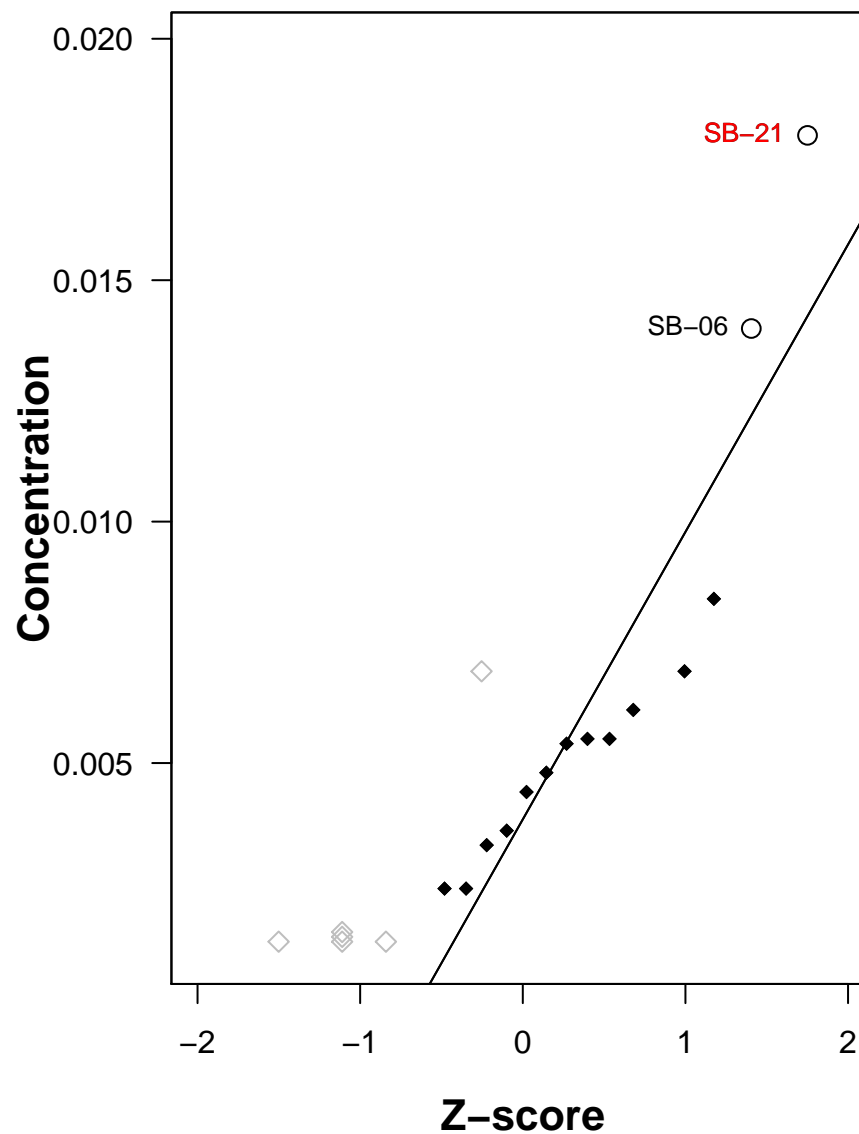
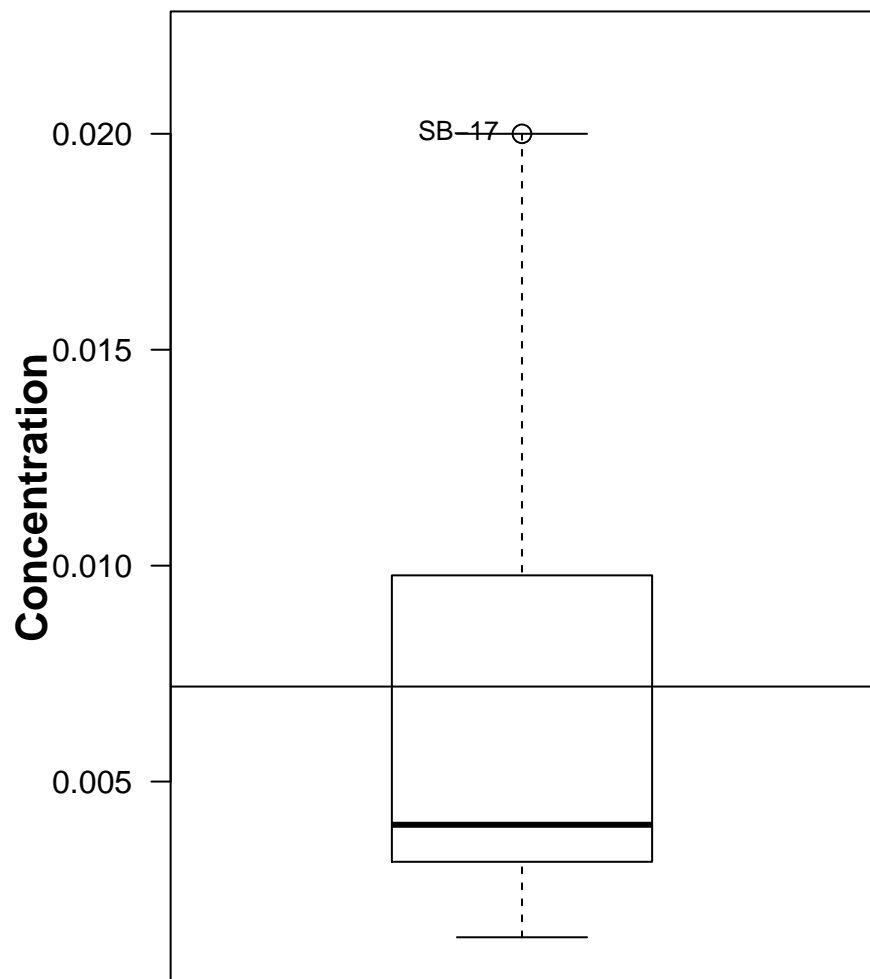


Figure B-66. SW8270, Di-n-butyl phthalate (mg/Kg)

Tidal Influence samples

Det/N=14/20, Normal

Box Plot



Normal Probability Plot

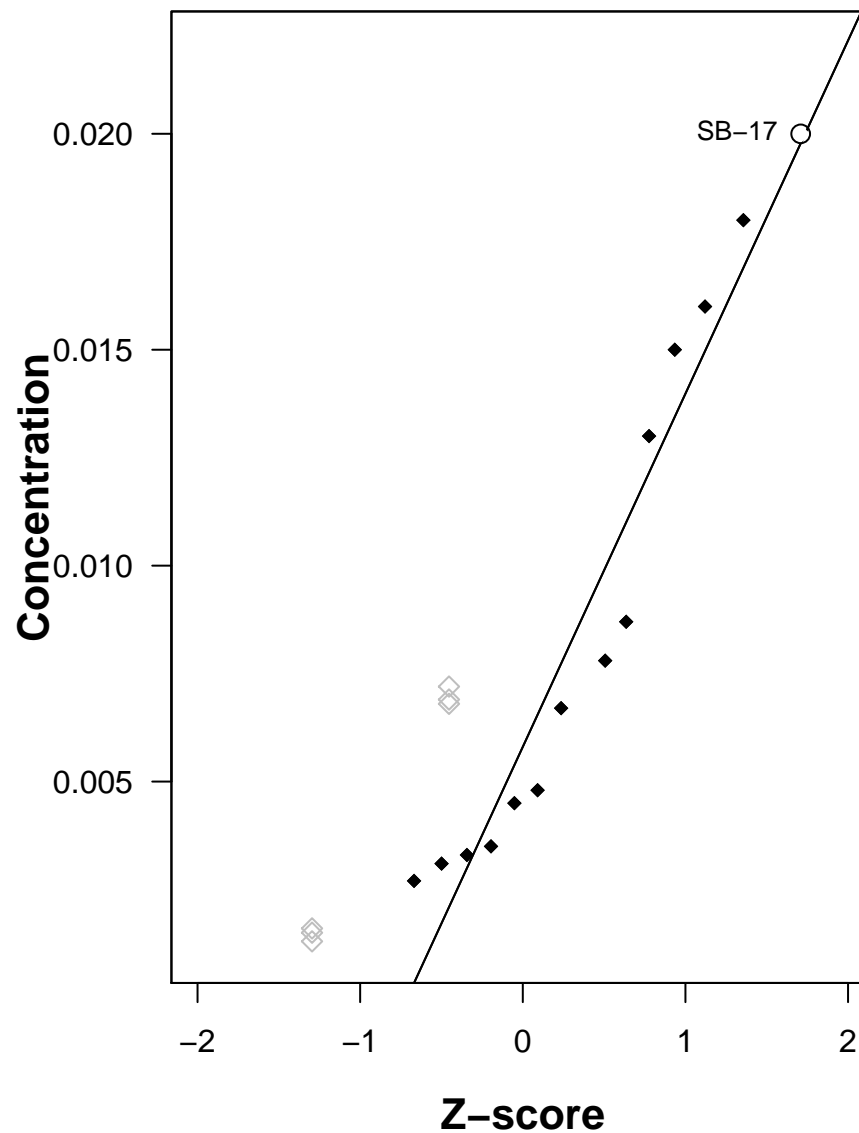
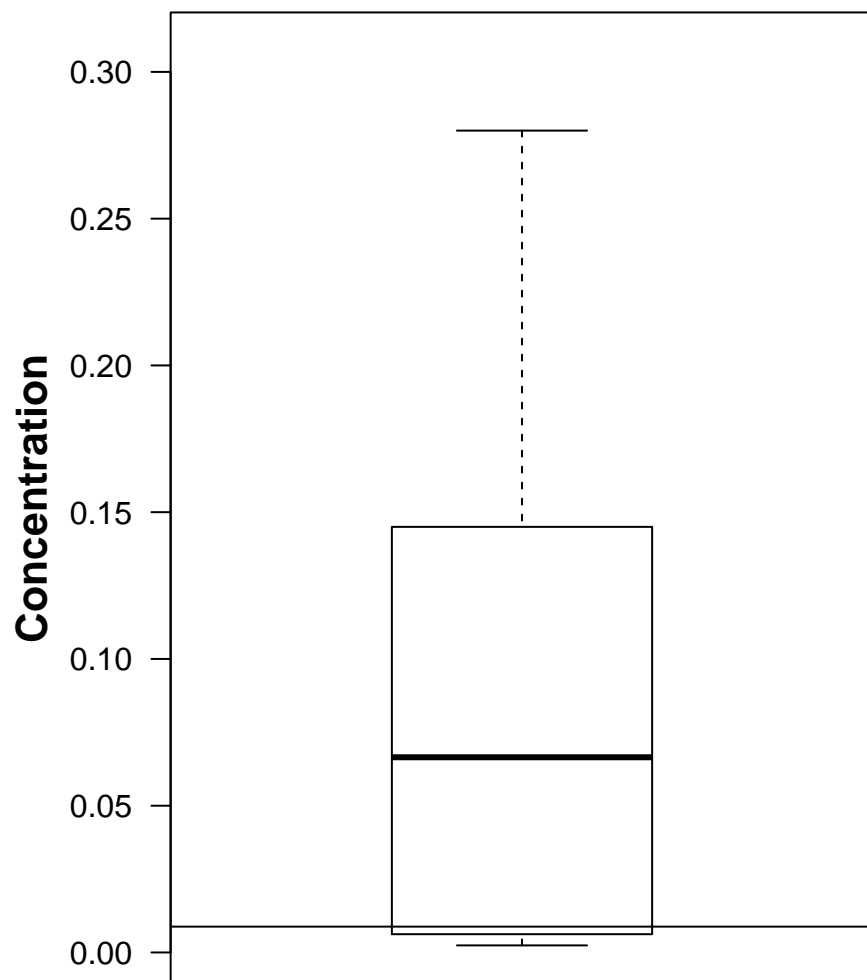


Figure B-67. SW8270, Dibenz(a,h)anthracene (mg/Kg)

Surface soil (0-0.5 feet) samples

Det/N=23/30, Normal

Box Plot



Normal Probability Plot

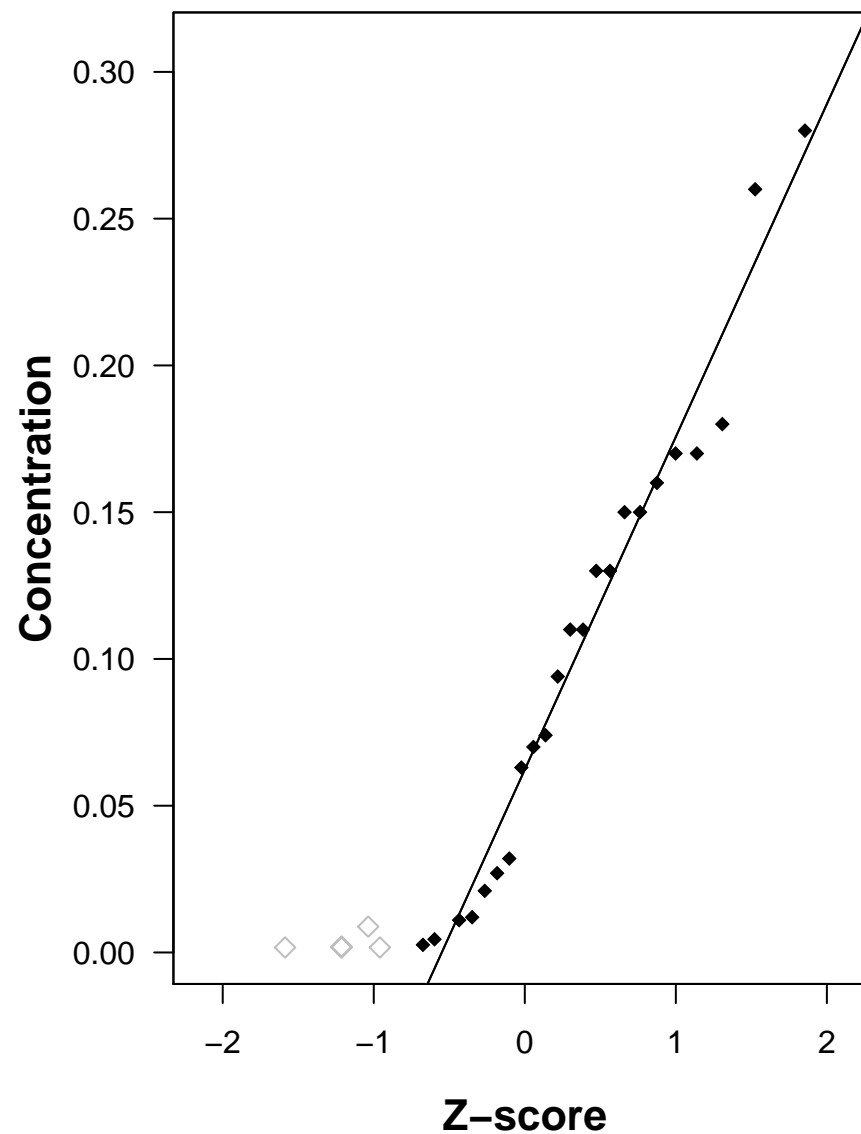
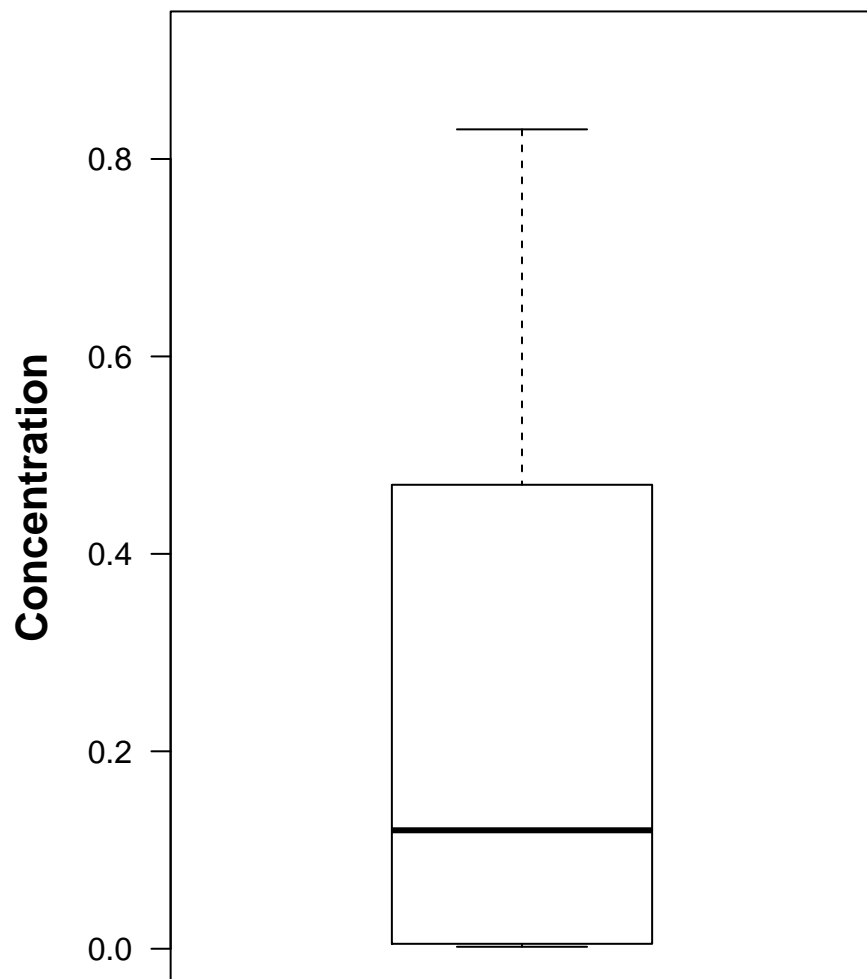


Figure B-68. SW8270, Fluoranthene (mg/Kg)

No Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=20/20, Gamma

Box Plot



Normal Probability Plot

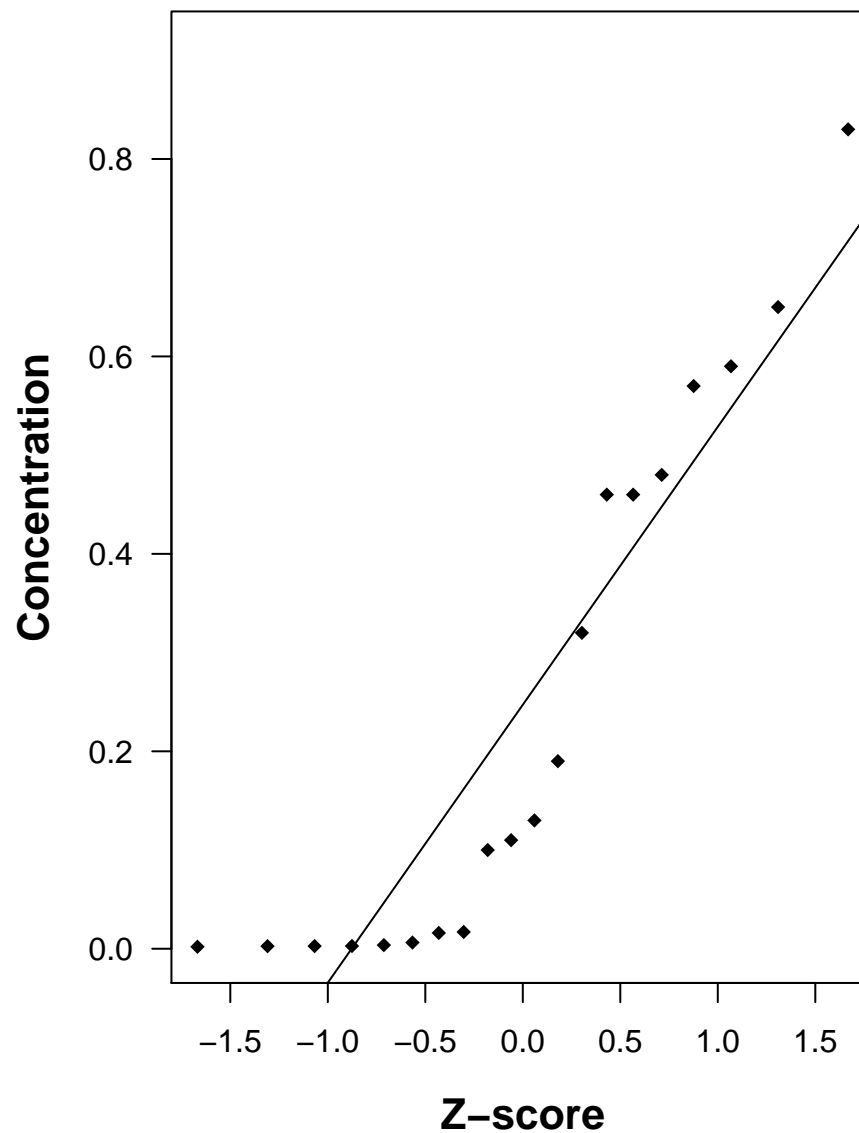
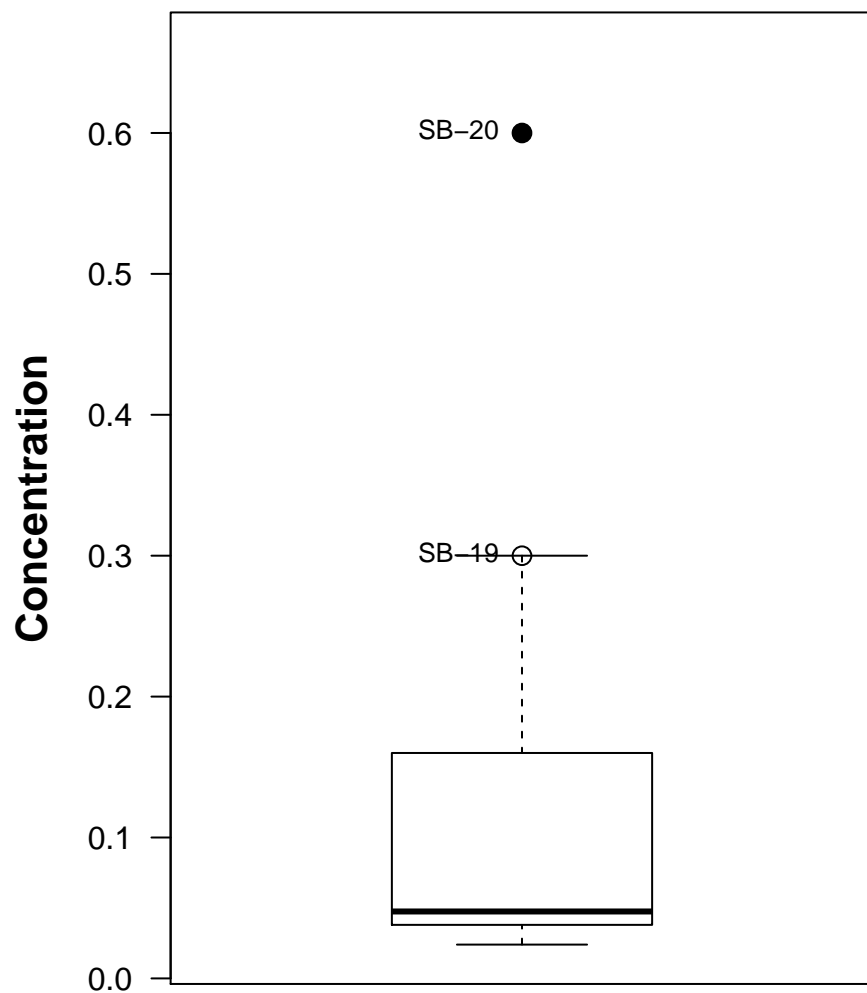


Figure B-69. SW8270, Fluoranthene (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=10/10, Gamma

Box Plot



Normal Probability Plot

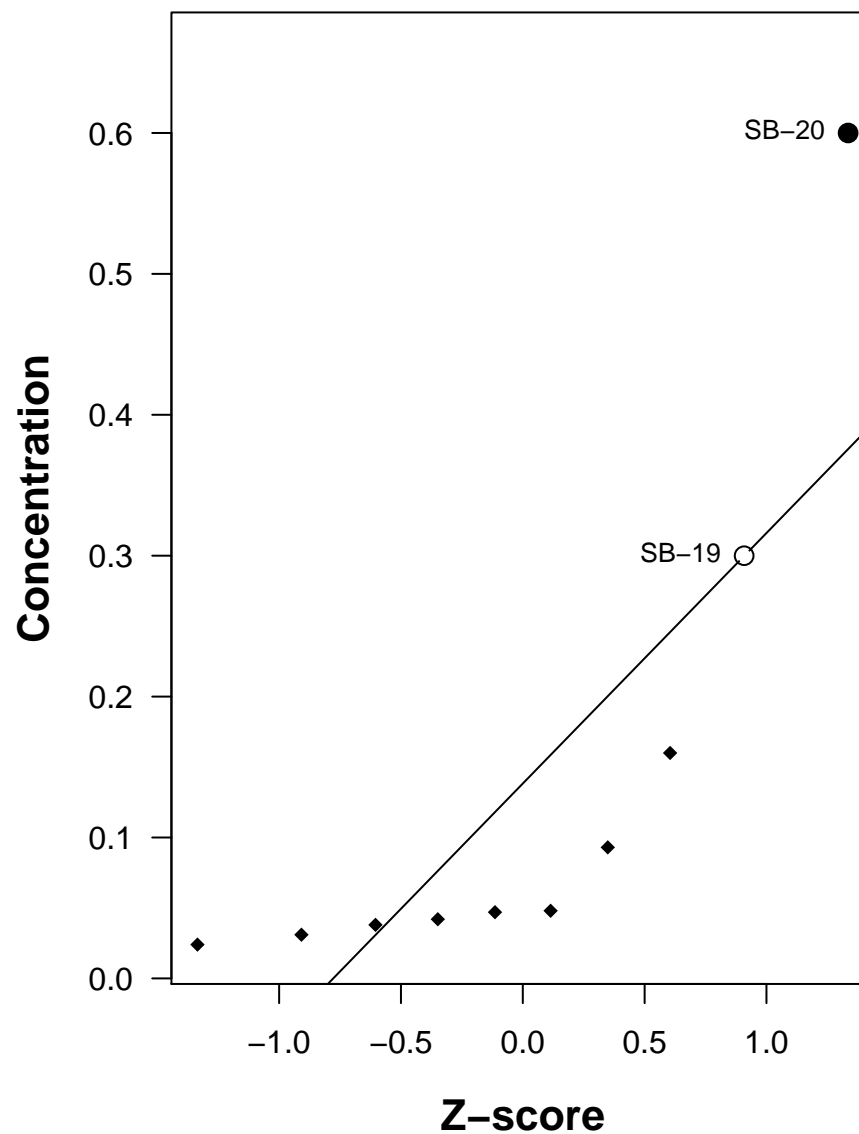
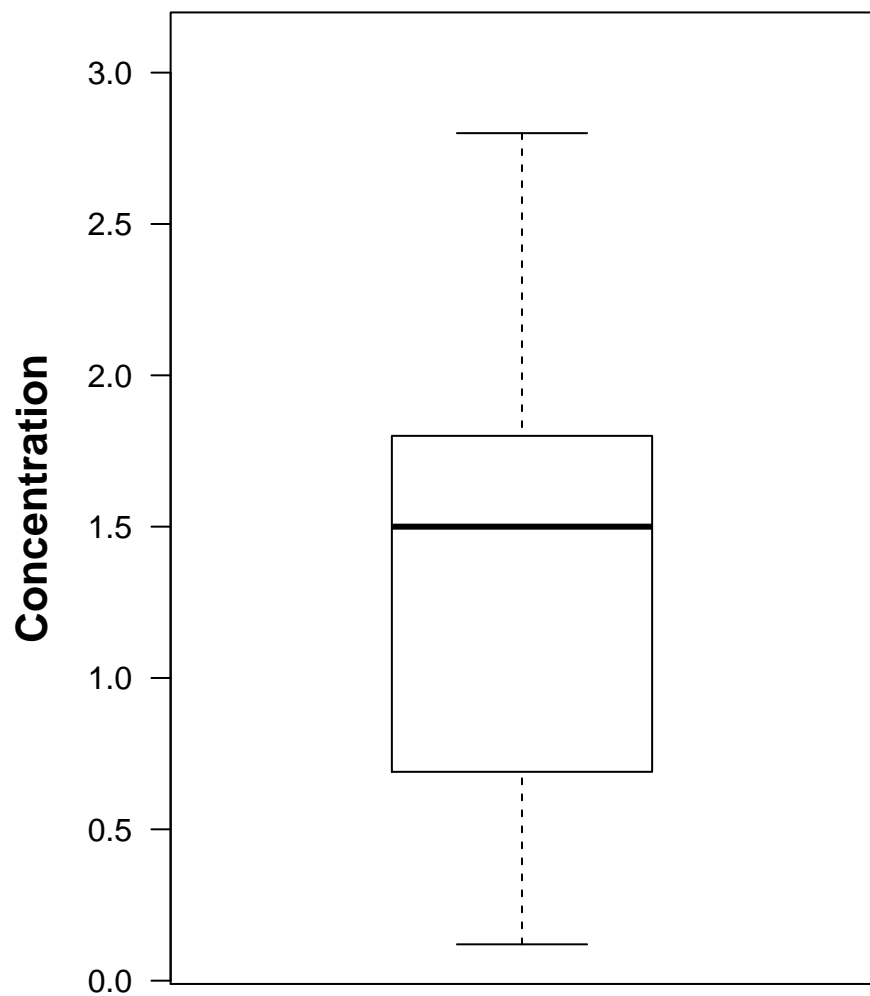


Figure B-70. SW8270, Fluoranthene (mg/Kg)

Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

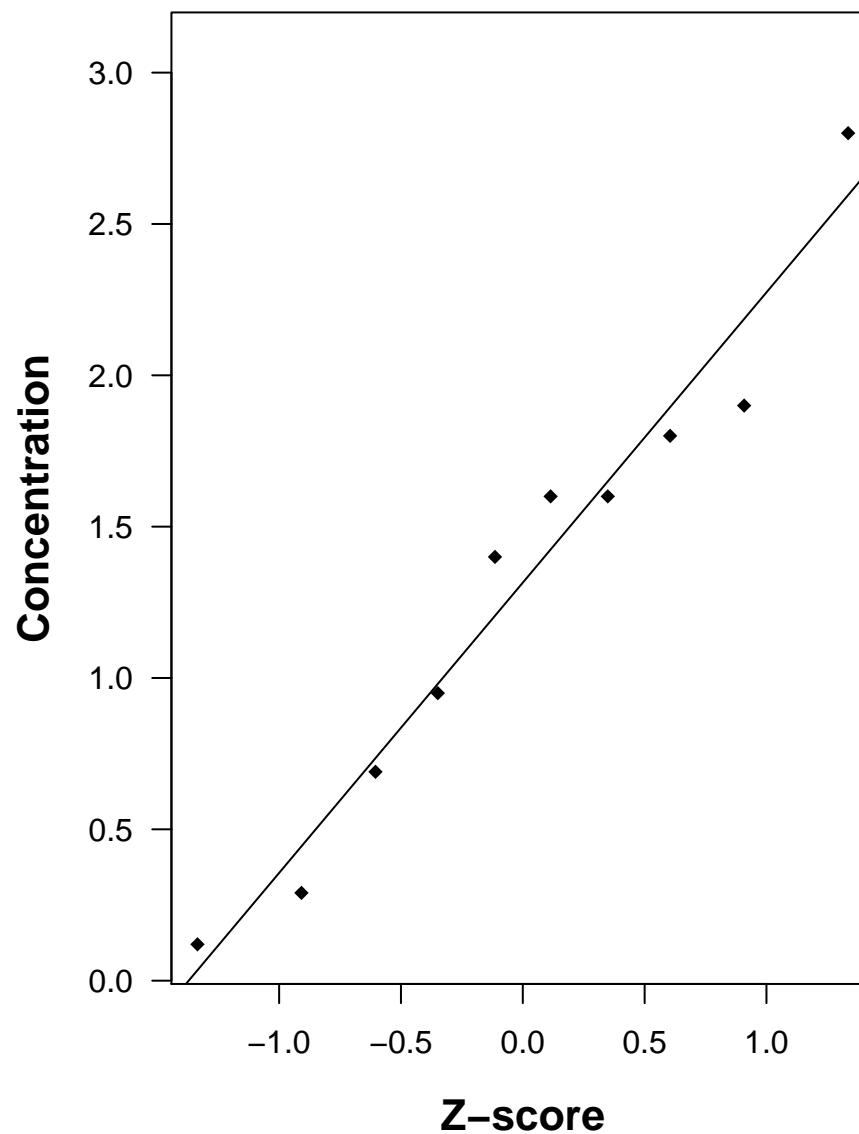
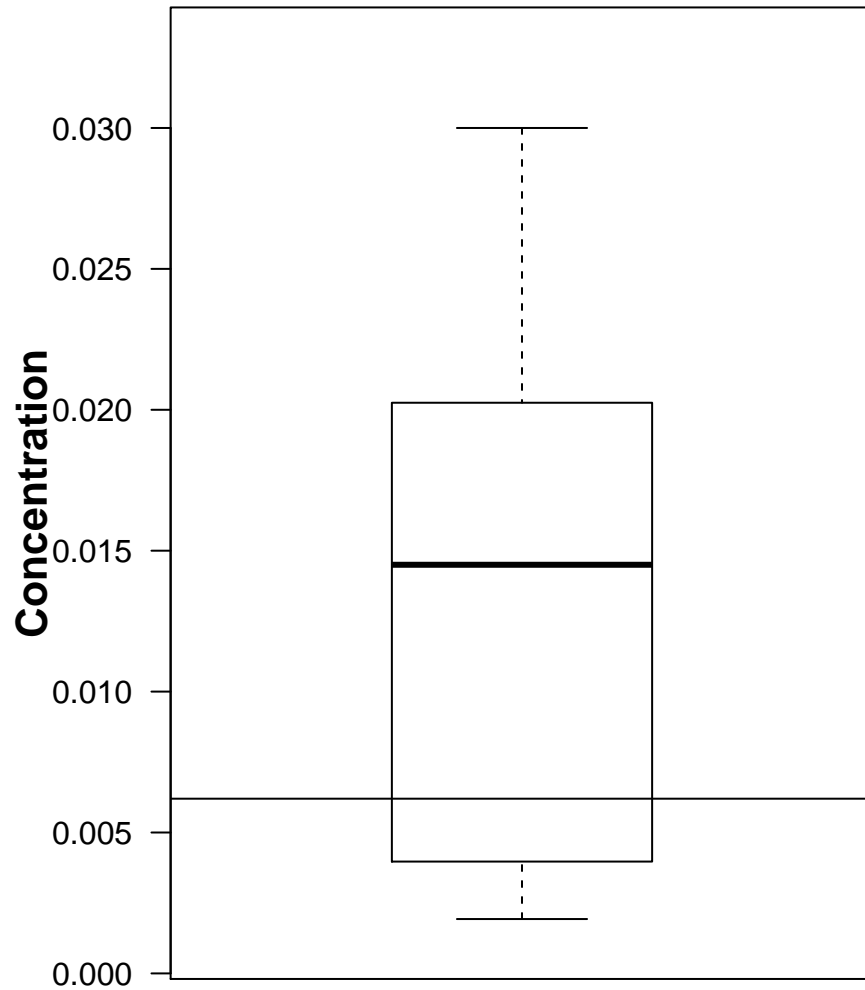


Figure B-71. SW8270, Fluorene (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=8/10, Normal

Box Plot



Normal Probability Plot

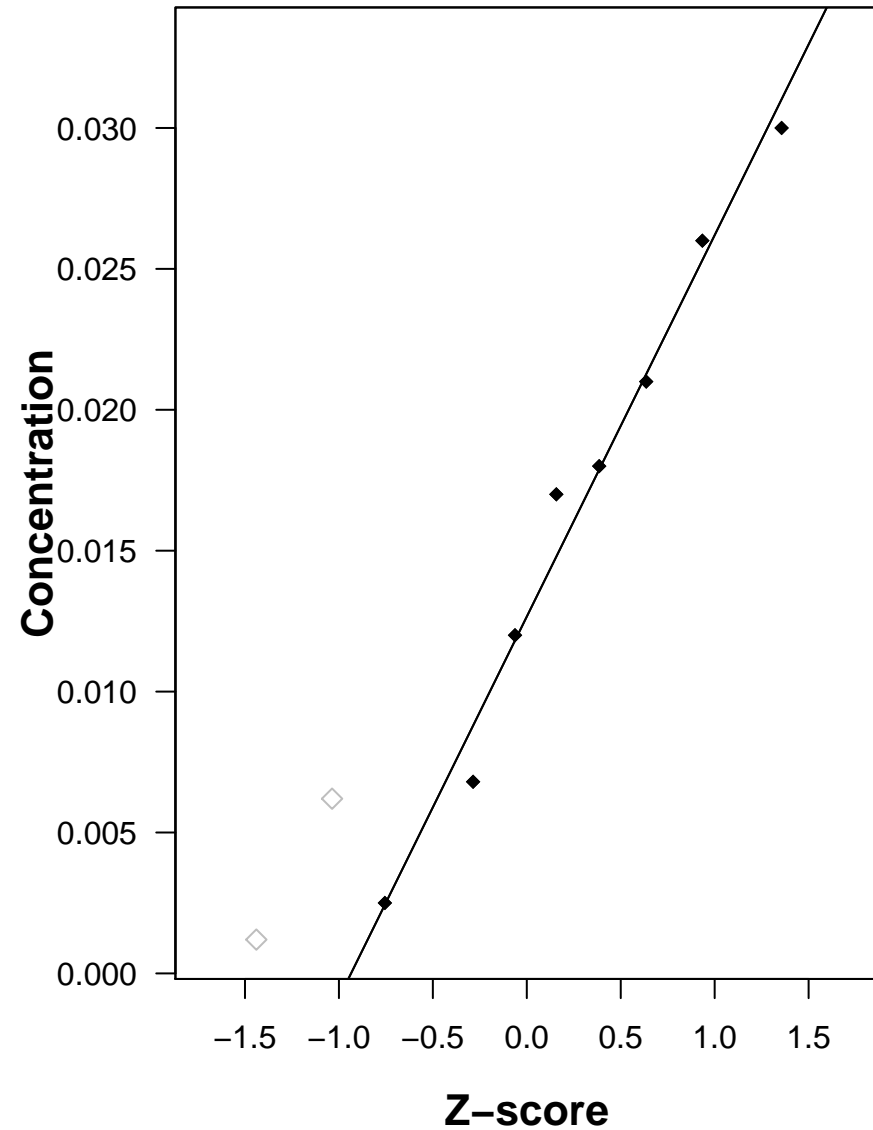
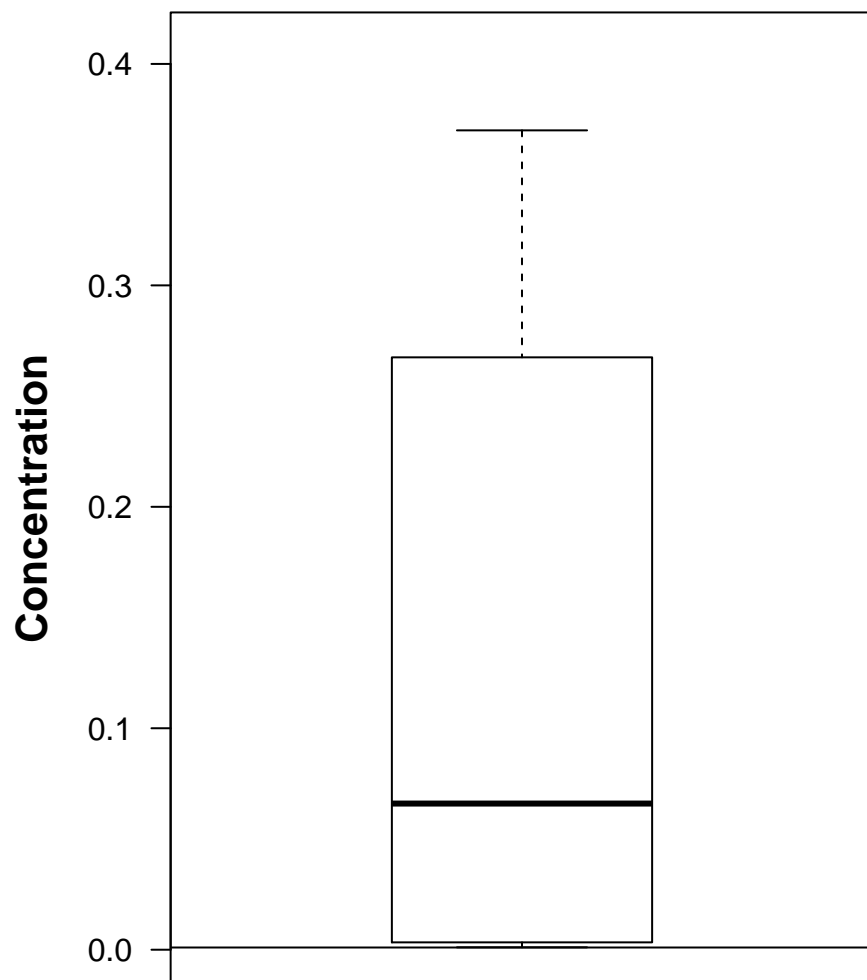


Figure B-72. SW8270, Indeno(1,2,3-cd)pyrene (mg/Kg)

No Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=17/20, Gamma

Box Plot



Normal Probability Plot

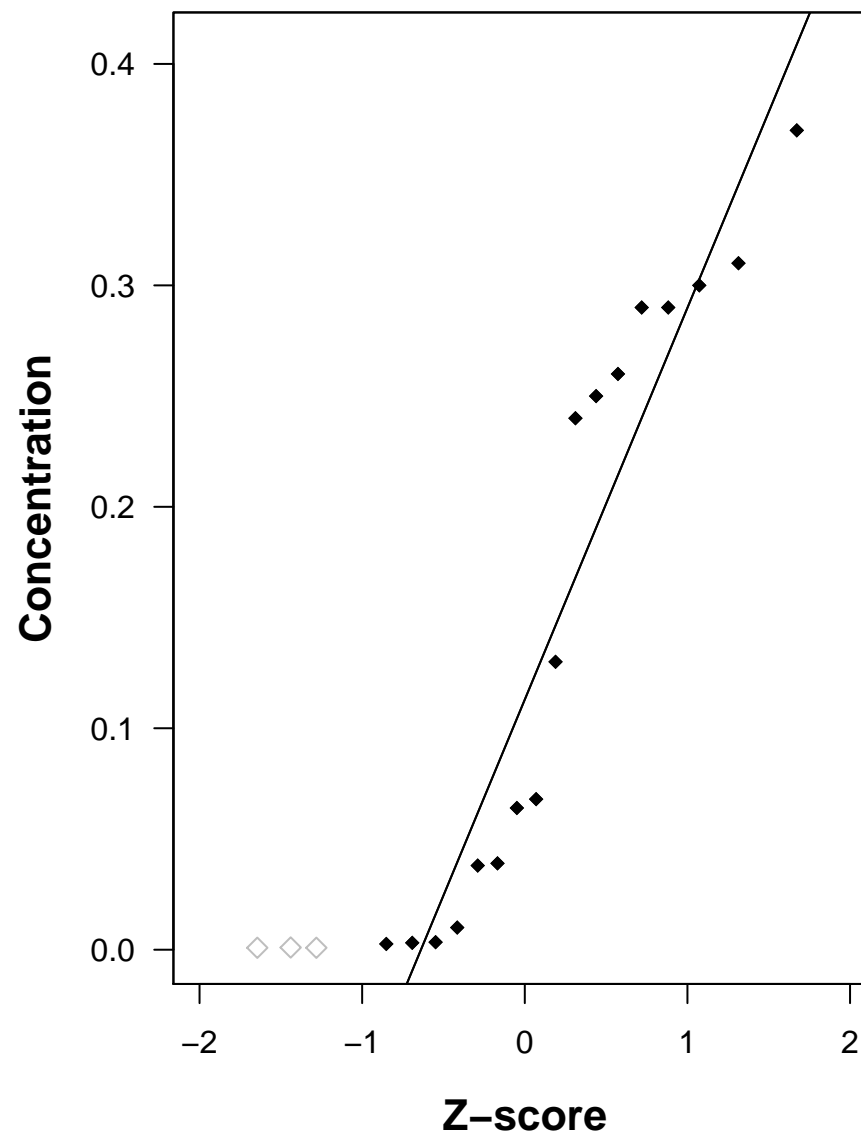
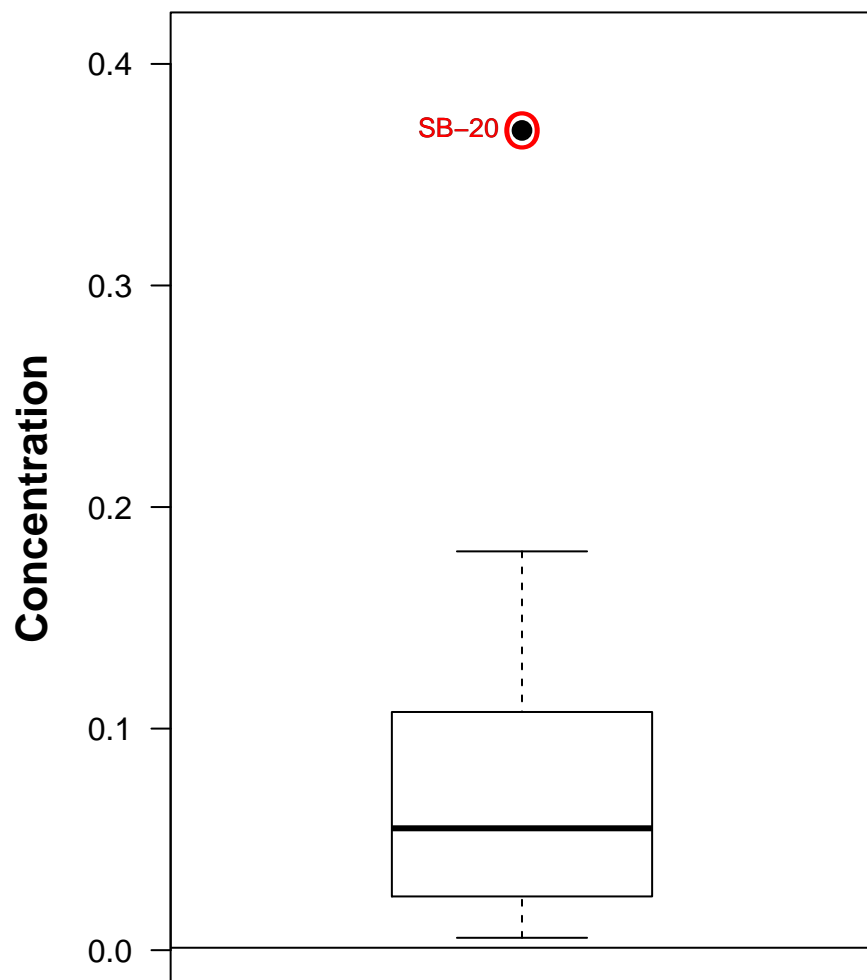


Figure B-73. SW8270, Indeno(1,2,3-cd)pyrene (mg/Kg)

Tidal Influence Shallow soil (1-2 feet) samples

Det/N=9/10, Normal

Box Plot



Normal Probability Plot

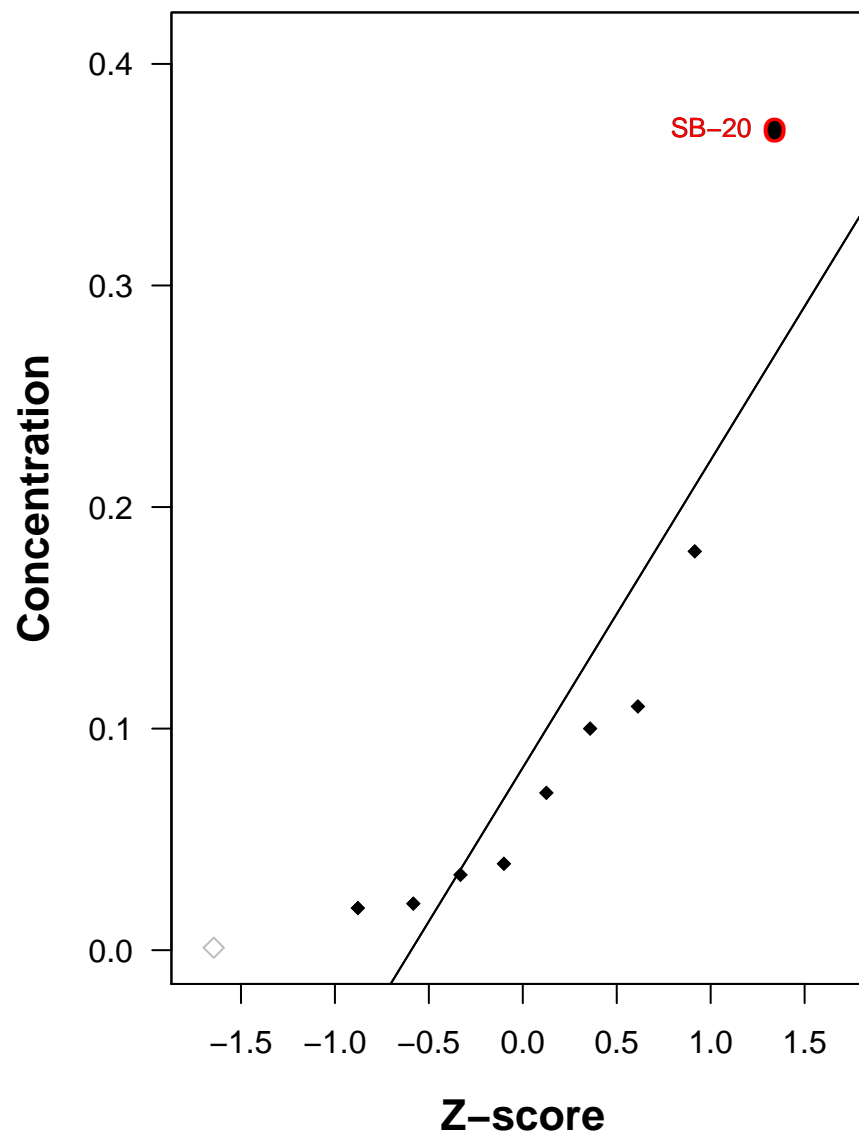
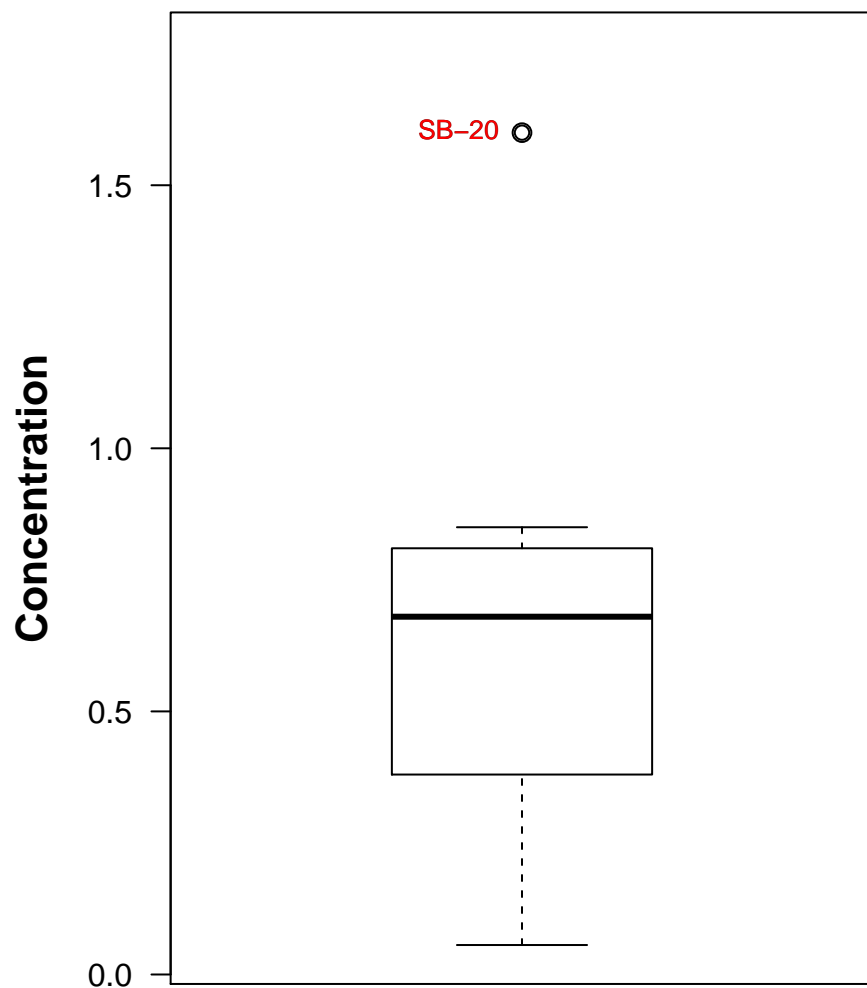


Figure B-74. SW8270, Indeno(1,2,3-cd)pyrene (mg/Kg)

Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

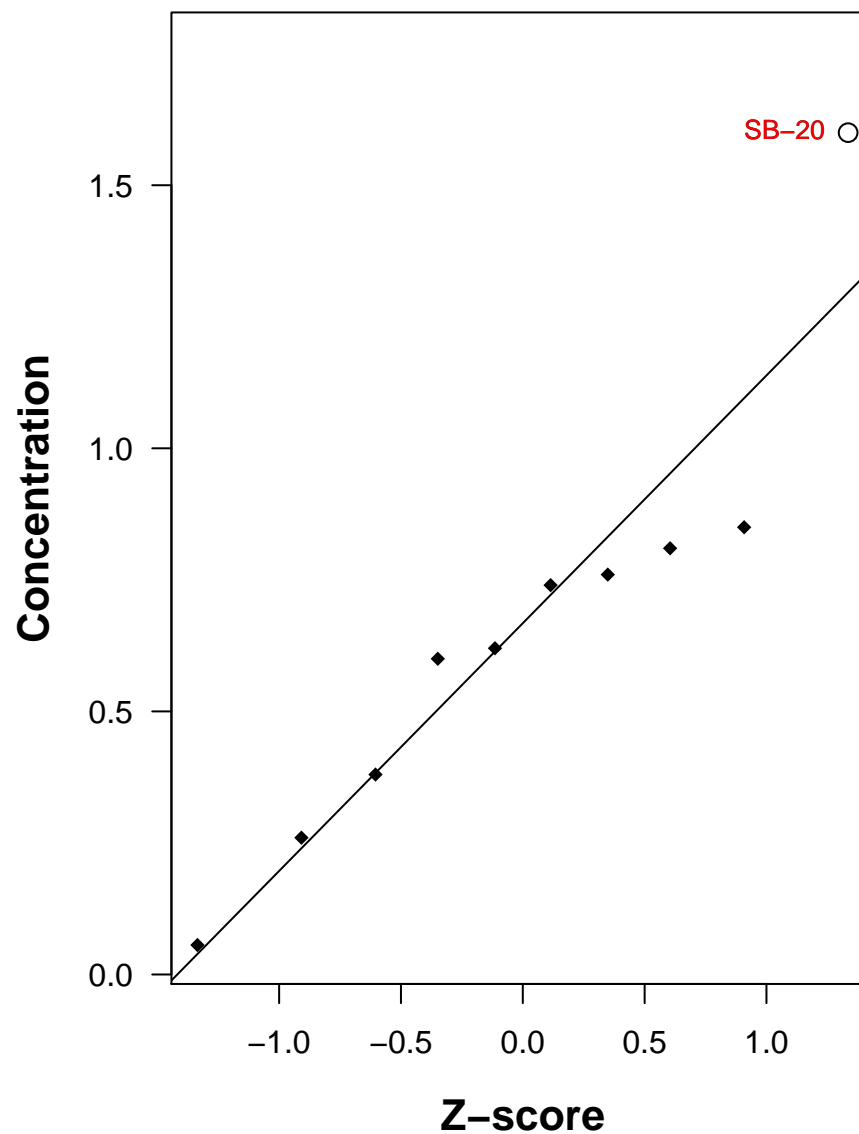
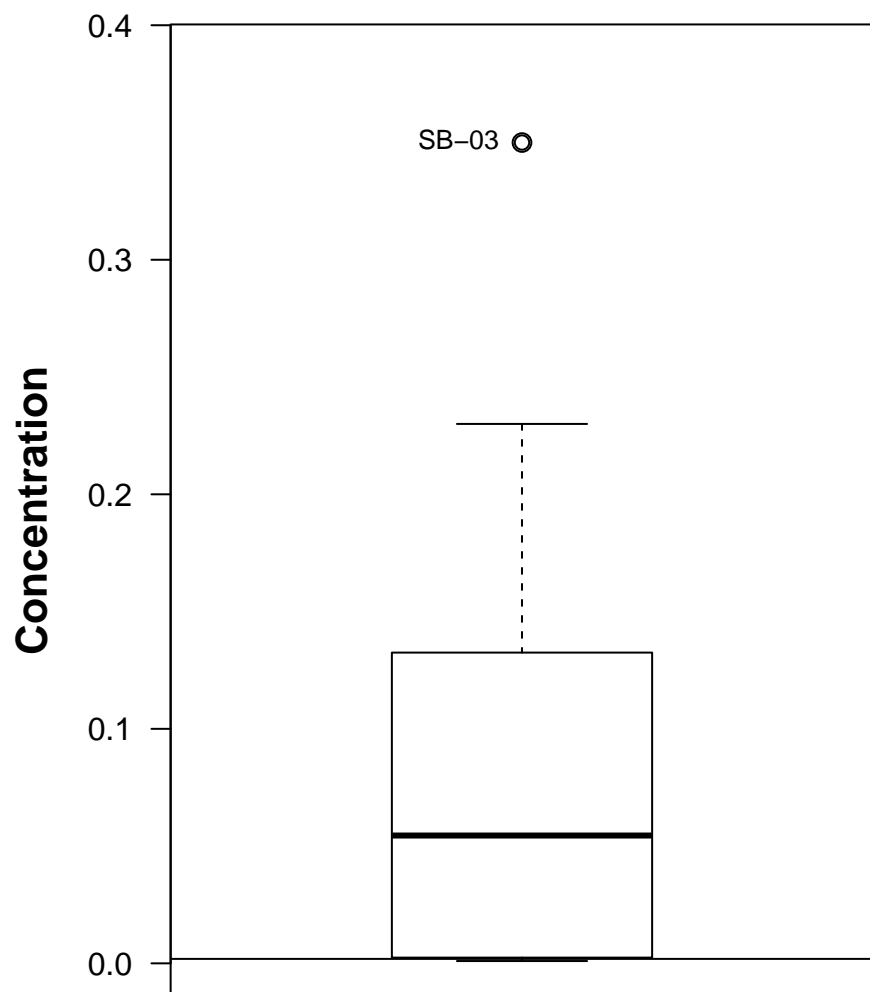


Figure B-75. SW8270, Phenanthrene (mg/Kg)

No Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=16/20, Normal

Box Plot



Normal Probability Plot

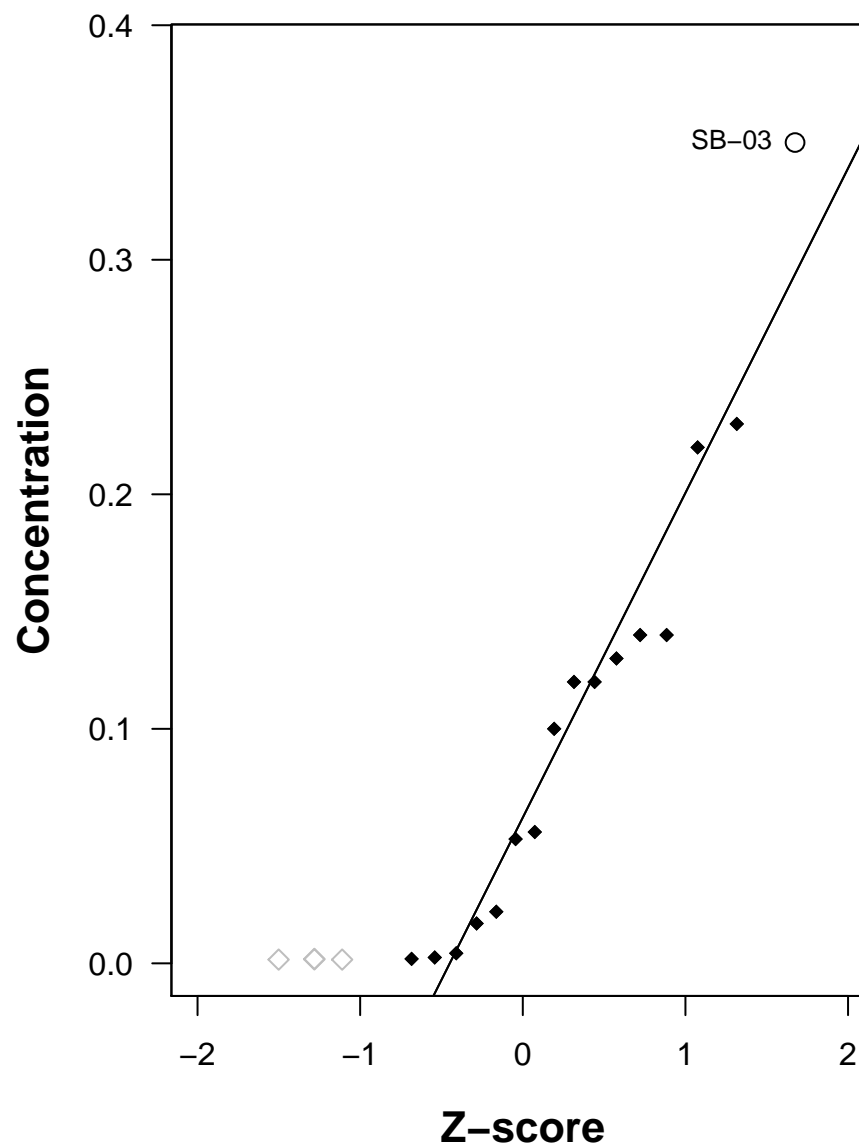
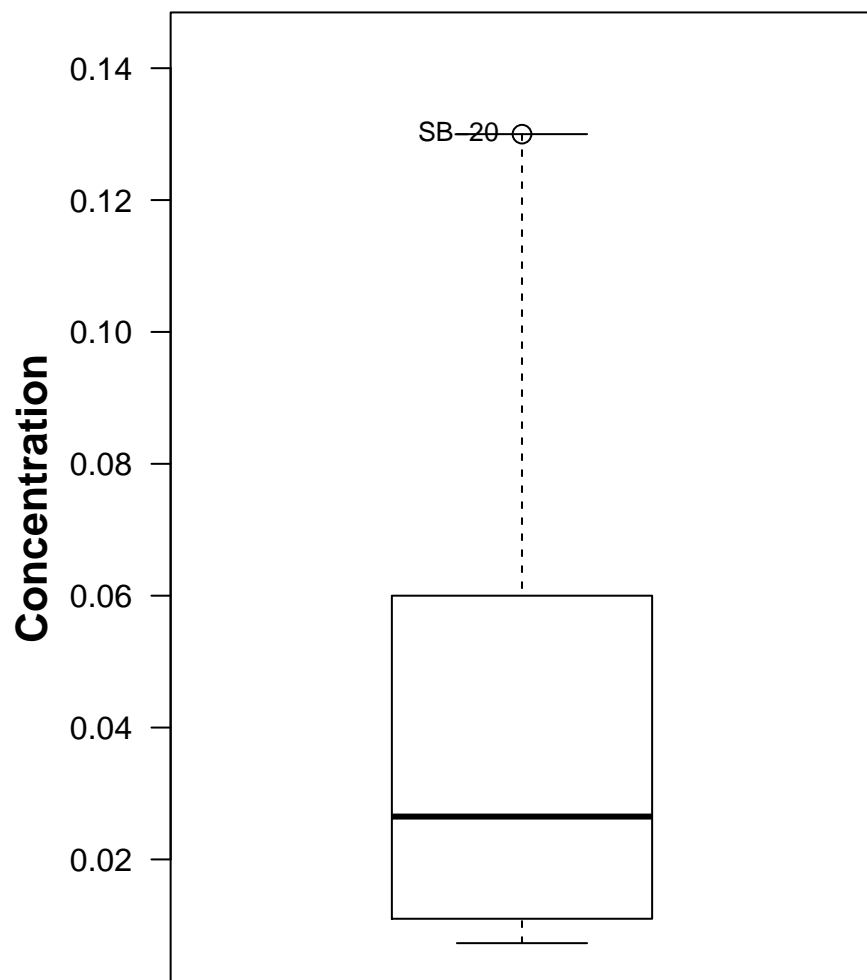


Figure B-76. SW8270, Phenanthrene (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=10/10, Gamma

Box Plot



Normal Probability Plot

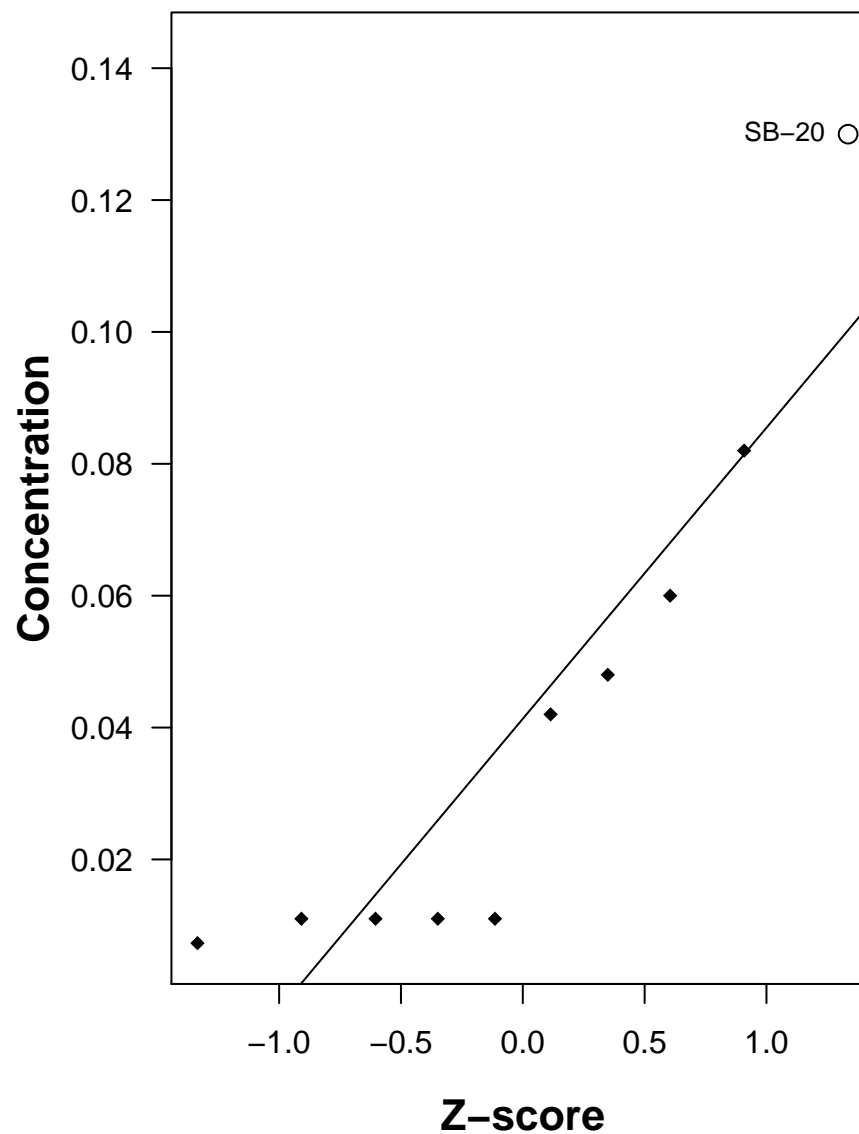
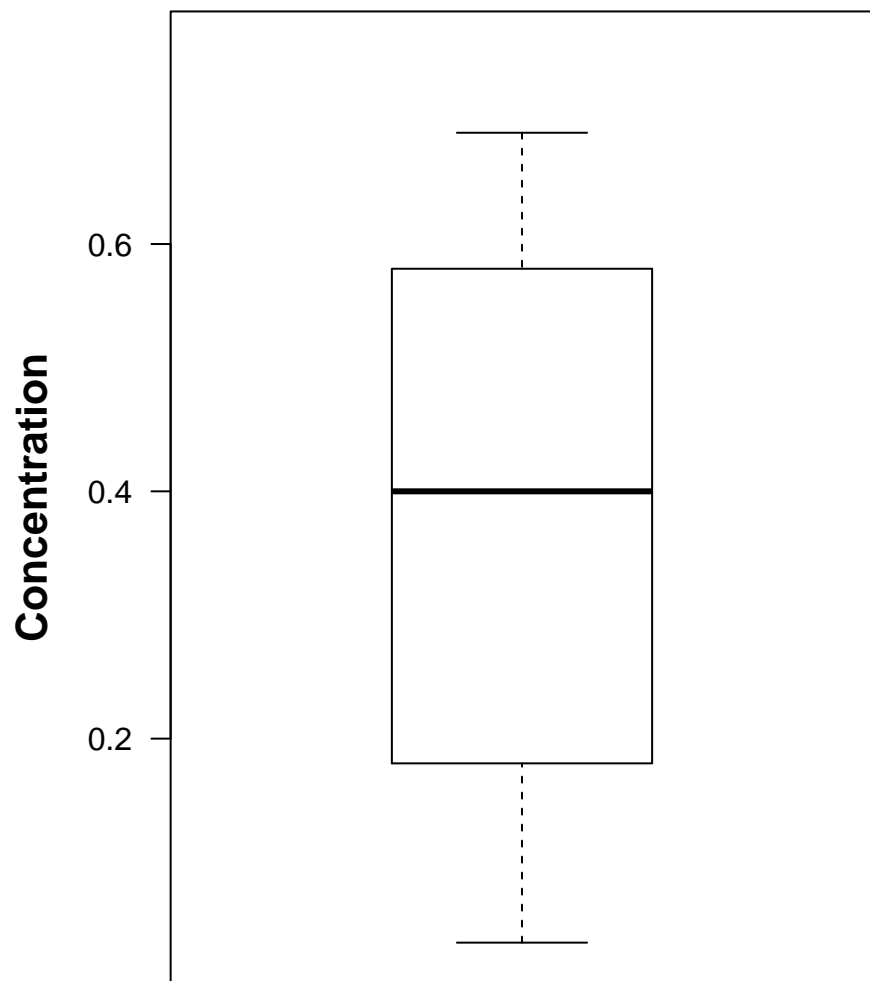


Figure B-77. SW8270, Phenanthrene (mg/Kg)

Tidal Influence Surface soil (0–0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot

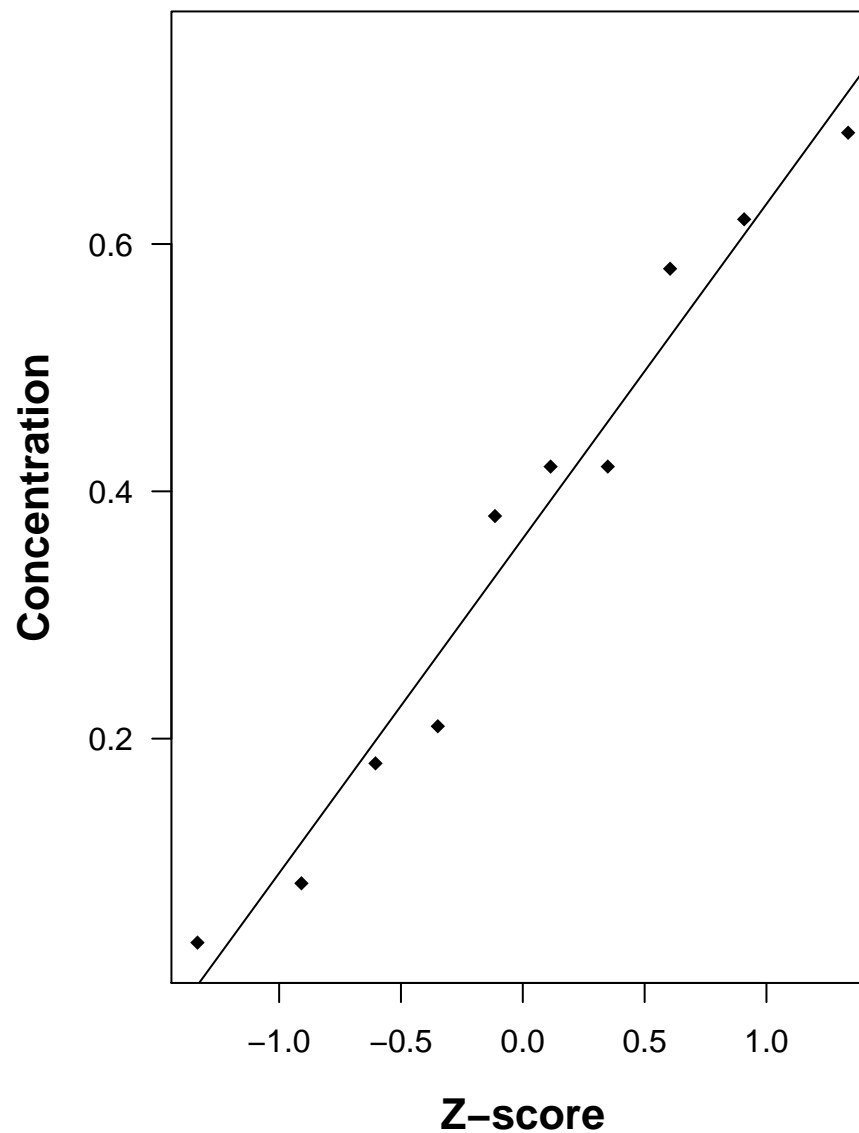
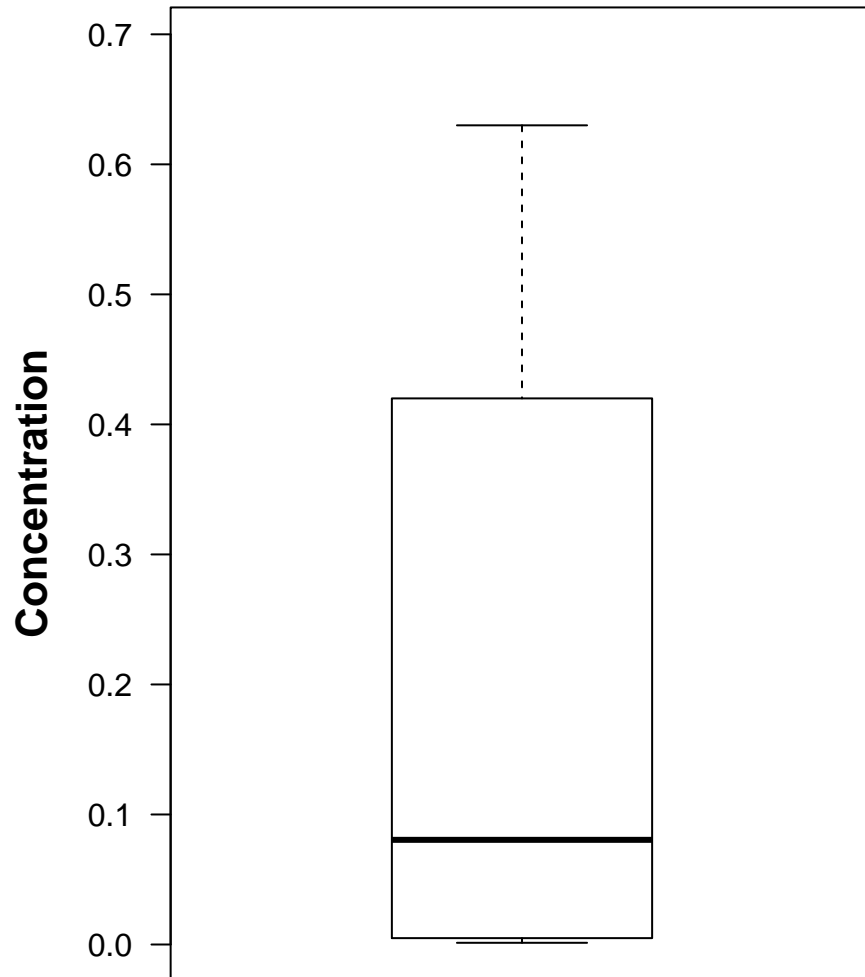


Figure B-78. SW8270, Pyrene (mg/Kg)

No Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=20/20, Gamma

Box Plot



Normal Probability Plot

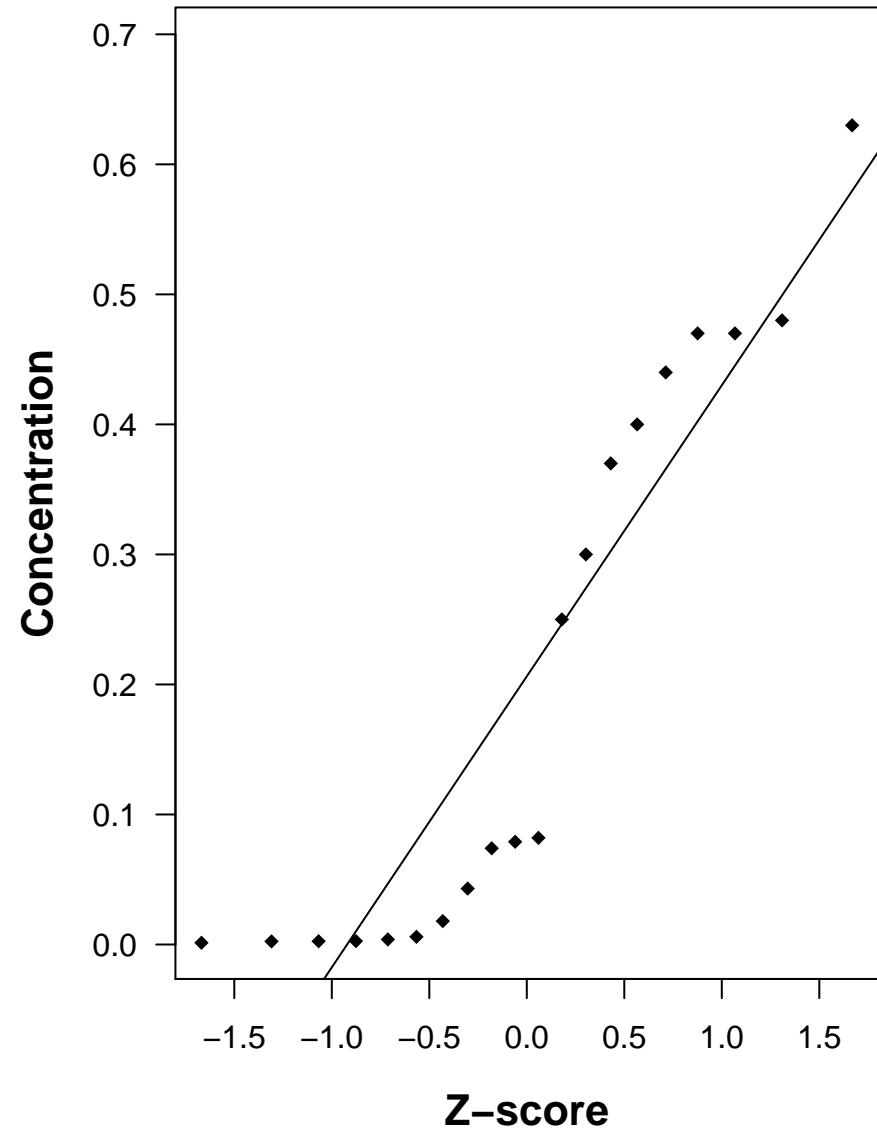
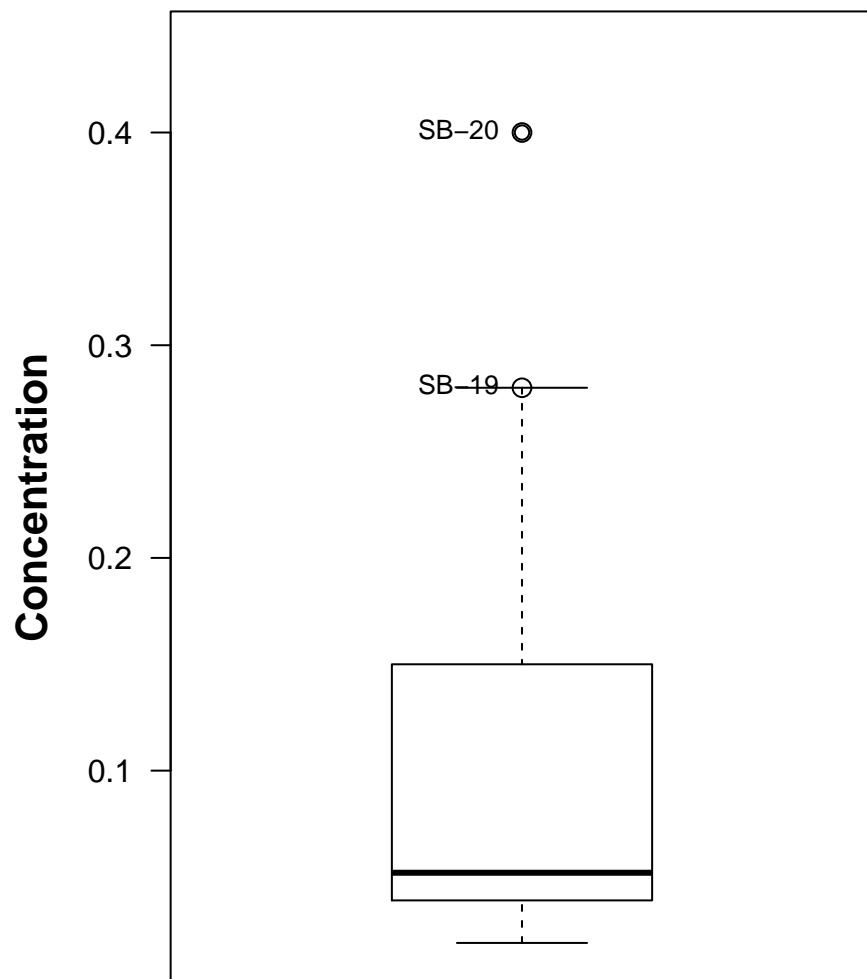


Figure B-79. SW8270, Pyrene (mg/Kg)

Tidal Influence Shallow soil (1–2 feet) samples

Det/N=10/10, Gamma

Box Plot



Normal Probability Plot

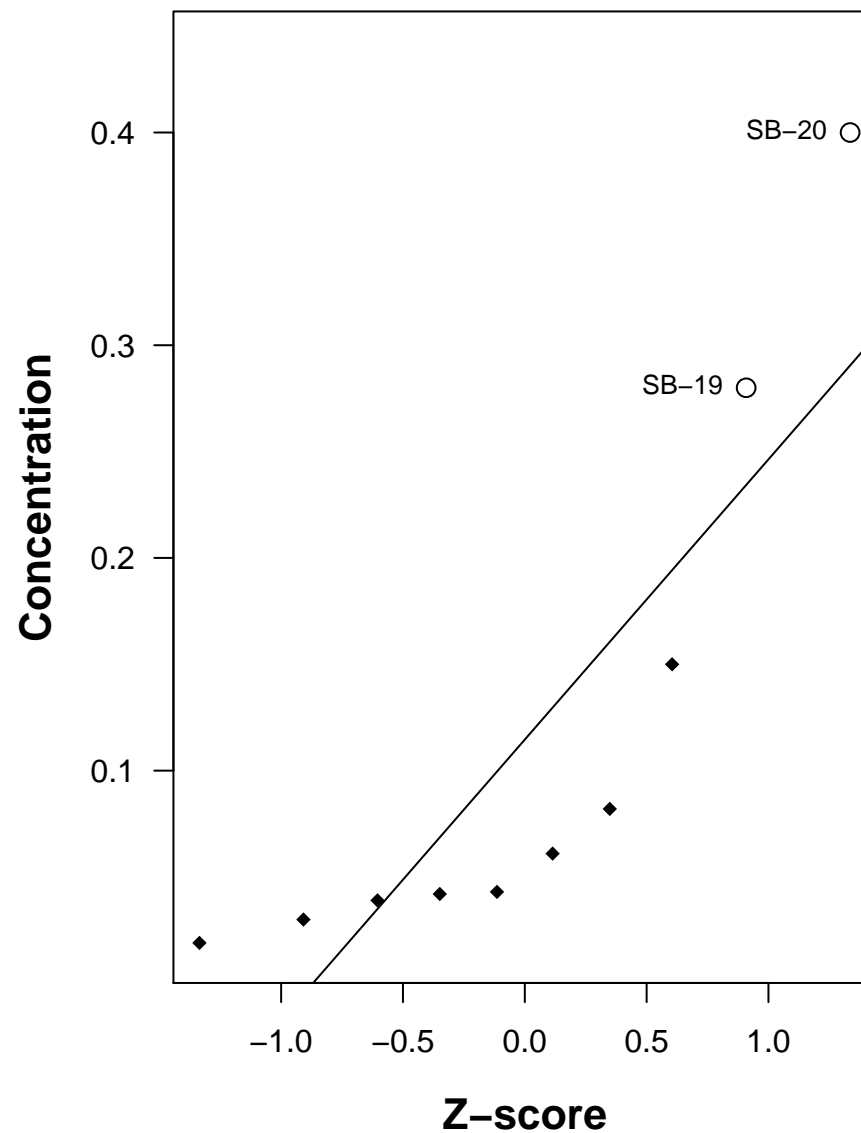
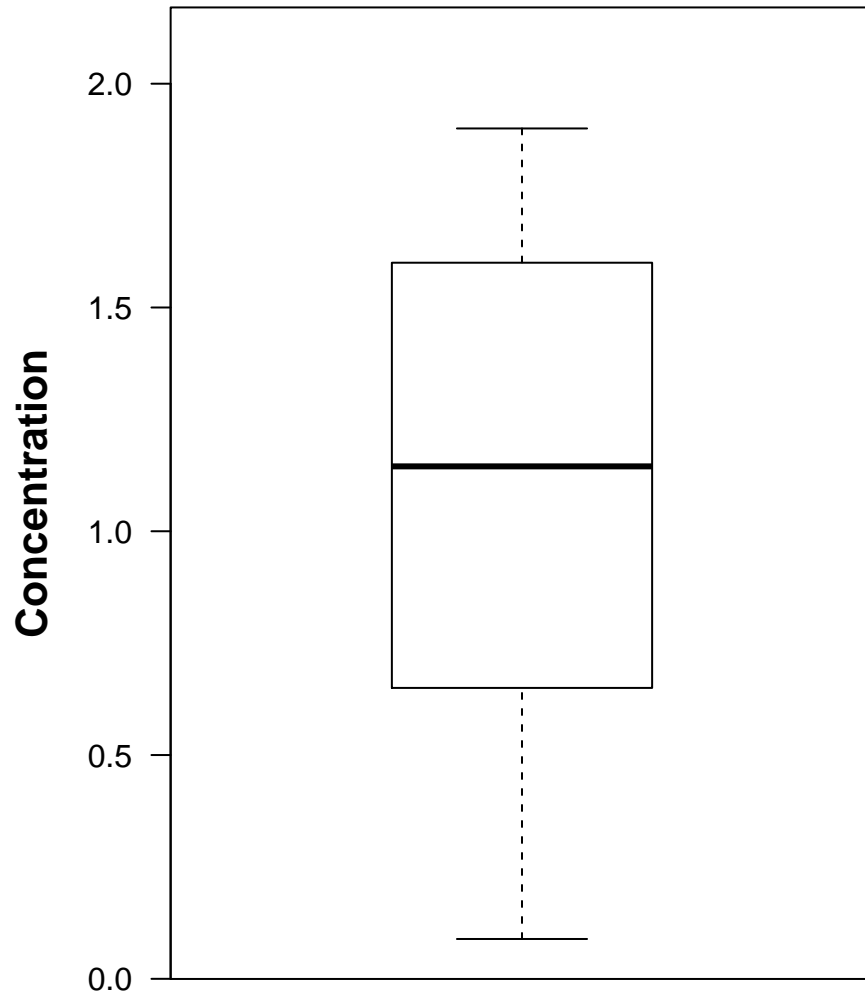


Figure B-80. SW8270, Pyrene (mg/Kg)

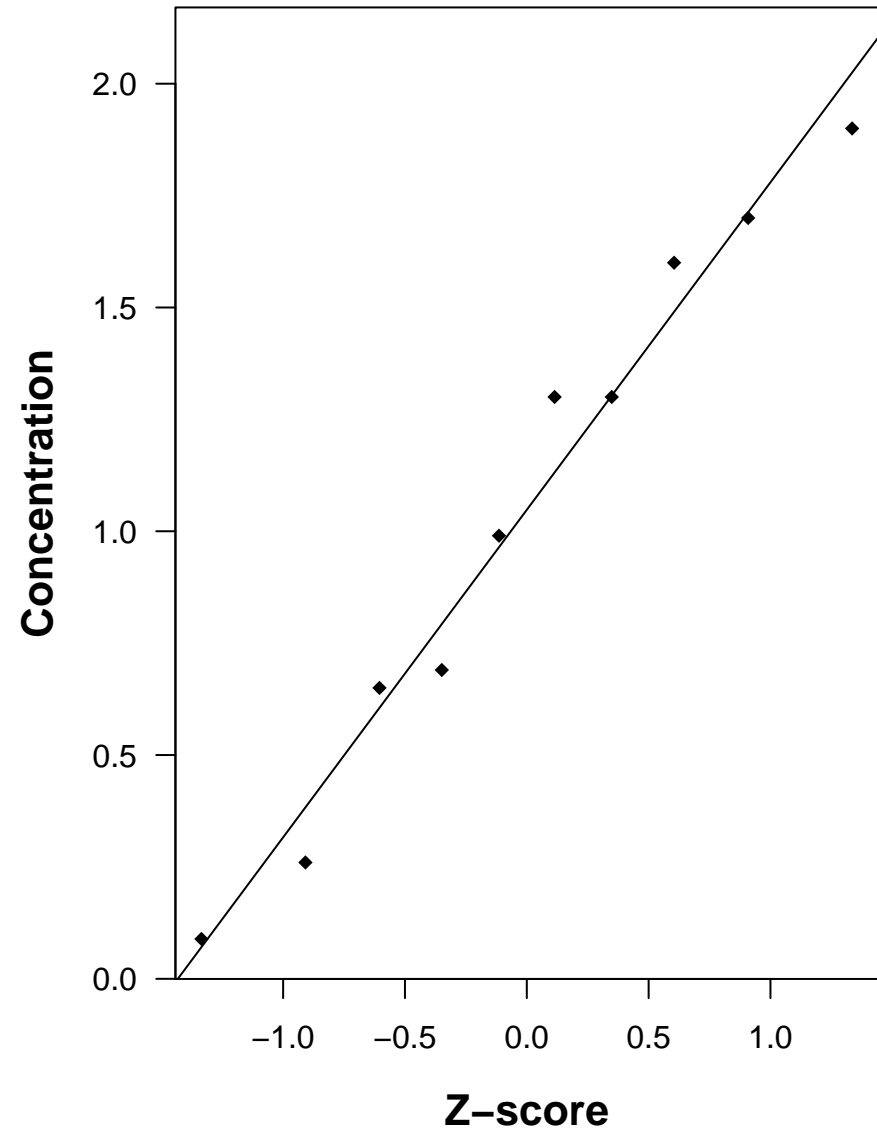
Tidal Influence Surface soil (0-0.5 feet) samples

Det/N=10/10, Normal

Box Plot



Normal Probability Plot



Attachment C – Calculating Upper Tolerance Limits

At this stage of the process, each data group's distribution was defined and summary statistics including UTLs were calculated. The open source, statistical software **R** (The R Foundation, 2017) was used to perform all statistical distribution tests and to calculate summary statistics and UTLs.

Defining a Data's Distribution

Summary statistics were based on each data group's defined distribution. Figure 4 outlines the process to define whether a data group follows a normal, gamma, lognormal, or nonparametric distribution. If there were no detections for a data group, no distribution was defined. For a data group with 60% or fewer detected concentrations, the distribution was defined as nonparametric. Typically, nonparametric approaches are used when there are fewer than 50% detected concentrations (EPA, 2000; EPA, 2009). For this background study, however, a more conservative approach was taken using 60% as the threshold. Using this approach, summary statistics and UTLs were not artificially influenced by the type of adjustments made for non-detect concentrations. A data's distribution was defined as nonparametric for a constituent with 60% or fewer detected concentrations so that summary statistics may not overestimate true background concentrations.

For each constituent's data group with more than 60% of detected concentrations, the data's distribution was tested using distributional tests, which include the Shapiro-Wilks test, Kolmogorov-Smirnov test, PPCC test, and Anderson-Darling test. The Anderson-Darling test was performed to test if the data followed a gamma distribution only. A test for the gamma distribution was included because EPA, 2017 generally recommends using summary statistics from a gamma distribution before using statistics from a lognormal distribution when both the gamma and lognormal distributional assumptions are valid.

All of these distributional tests are recommended by EPA (EPA, 2000; EPA, 2002; EPA, 2009; EPA, 2017). Each distributional test was performed twice:

- Once with the all of the data (detects and non-detects), including adjustments made for

- non-detect concentrations, as described in the memo's Data Preparation section; and
- Once with only the detected data, which is similar to how ProUCL performs distributional tests.

Running distributional tests with only detected data follows the procedures in EPA, 2017.

Furthermore, the method used to draw distributional conclusions, which uses the largest p-value from all of the appropriate tests and compares it to a 95% level of significance, was designed to follow ProUCL's distributional recommendations. It should be noted that for data groups with more than 60% and less than 85% detected sample concentrations, the Kolmogorov-Smirnov test could not be performed using all of the data. Also, the Shapiro-Wilks test was not performed using all of the data when multiple censoring concentrations for non-detects were present.

If results from any of the six tests (using the Shapiro-Wilks, Kolmogorov-Smirnov, and PPCC tests for all the data and for only the detected data) indicate the data are normally distributed (when the largest p-value is greater than 0.05), the distribution was defined as normal. If none of the six test results indicate normality and the data have at least 85% detected concentrations, the data were tested for the gamma distribution. This was accomplished by running all eight distributional tests using the Shapiro-Wilks, Kolmogorov-Smirnov, PPCC, and Anderson-Darling tests with all of the data and with only the detected data. If any of the eight tests indicated the data follow a gamma distribution (when the largest p-value is greater than 0.05), the distribution was defined as a gamma distribution. If none of the eight test results indicated a gamma distribution or if the data have more than 60% and fewer than 85% detected concentrations, the data were tested for lognormality by running the Shapiro-Wilks, Kolmogorov-Smirnov, and PPCC tests with the natural-log transformed data, for all of the data and for detected data only. If results from any of these six tests indicated the data are lognormally distributed (when the largest p-value is greater than 0.05), the distribution was defined as lognormal. If none of the distributional test results indicate normality, a gamma distribution, or lognormality, the data's distribution was defined as nonparametric.

Calculating Summary Statistics

Table C-1 presents the summary statistics that were calculated for each constituent and data grouping. Summary statistics were calculated using the open source, statistical software **R**. For a constituent with more than 60% detections, the mean, standard deviation, and UTL were

adjusted for non-detected concentrations, as described previously. For a constituent with 60% or fewer detections, no mean and standard deviation were calculated. In addition, for data groups with 60% or fewer detections, a nonparametric UTL was estimated. According to EPA guidance, using the UTL as a representative background concentration is appropriate for comparisons to site concentrations (EPA, 2002). UTLs were used to define the representative background concentrations by taking the higher of the UTL and the Texas-specific soil background concentration per 30 TAC 350.51(m) for each constituent.

ATTACHMENT C TABLES

Table C-1
Summary Statistics
Background Soil Study
US Oil Recovery Superfund Site

Constituent	Data Set	# Detects/ # Samples	% of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Mean	Standard Deviation	95/95 UTL	Comment
Aluminum	Shallow soil (1-2 feet) samples	30/30	100	5,620	18,000	10,900	3,940	19,600	Normal UTL
Aluminum	Surface soil (0-0.5 feet) samples	30/30	100	2,660	13,500	6,170	2,590	13,100	Gamma UTL
Antimony	All samples	20/60	33.3	0.217	0.636	NC	NC	0.64	Nonparametric UTL ⁽¹⁾
Arsenic	Shallow soil (1-2 feet) samples	30/30	100	2.23	30.4	6.97	6.94	30.4	Nonparametric UTL
Arsenic	Surface soil (0-0.5 feet) samples	30/30	100	1.23	8.77	3.47	1.77	7.97	Gamma UTL
Barium	Shallow soil (1-2 feet) samples	30/30	100	76.8	228	146	43.7	243	Normal UTL
Barium	Surface soil (0-0.5 feet) samples	30/30	100	50.9	252	106	40	205	Gamma UTL
Beryllium	Shallow soil (1-2 feet) samples	30/30	100	0.404	1.42	0.835	0.311	1.53	Normal UTL
Beryllium	Surface soil (0-0.5 feet) samples	30/30	100	0.201	1.09	0.503	0.191	0.985	Gamma UTL
Boron	Shallow soil (1-2 feet) samples	30/30	100	2.66	6.53	4.25	1.11	6.71	Normal UTL
Boron	Surface soil (0-0.5 feet) samples	29/30	96.7	1.4	5.86	3.59	1.11	6.05	Normal UTL
Cadmium	All samples	51/60	85	0.0717	1.21	0.261	0.209	0.775	Gamma UTL
Chromium	Shallow soil (1-2 feet) samples	30/30	100	9.62	28	16.4	3.71	24.6	Normal UTL
Chromium	Surface soil (0-0.5 feet) samples	30/30	100	2.33	21.4	10.9	4.65	21.3	Normal UTL
Cobalt	Shallow soil (1-2 feet) samples	30/30	100	4.65	17.1	7.94	3.35	16.1	Gamma UTL
Cobalt	Surface soil (0-0.5 feet) samples	30/30	100	1.91	36.1	6.5	6.08	36.1	Nonparametric UTL
Copper	No Tidal Influence samples	40/40	100	1.12	44.9	11.8	7.12	31.7	Gamma UTL
Copper	Tidal Influence samples	20/20	100	8.79	165	21.6	34.1	76.2	Gamma UTL
Lead	All samples	60/60	100	3.82	270	49.6	42.5	151	Gamma UTL
Manganese	Shallow soil (1-2 feet) samples	30/30	100	135	778	325	166	783	Gamma UTL
Manganese	Surface soil (0-0.5 feet) samples	30/30	100	46.4	997	227	170	609	Gamma UTL
Nickel	Shallow soil (1-2 feet) samples	30/30	100	7.51	18.3	12.7	2.65	18.6	Normal UTL
Nickel	Surface soil (0-0.5 feet) samples	30/30	100	2.51	18.9	9.26	3.84	17.8	Normal UTL
Selenium	No Tidal Influence Shallow soil (1-2 feet) samples	20/20	100	0.356	0.922	0.634	0.168	1.04	Normal UTL
Selenium	No Tidal Influence Surface soil (0-0.5 feet) samples	20/20	100	0.198	0.742	0.374	0.127	0.679	Normal UTL
Selenium	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.303	0.562	0.447	0.099	0.735	Normal UTL
Selenium	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.223	0.473	0.341	0.0821	0.58	Normal UTL
Silver	No Tidal Influence samples	10/40	25	0.09	0.647	NC	NC	0.647	Nonparametric UTL ⁽¹⁾
Silver	Tidal Influence samples	13/20	65	0.0907	0.717	0.0959	0.316	0.854	Normal UTL
Thallium	No Tidal Influence Shallow soil (1-2 feet) samples	17/20	85	0.0742	0.184	0.117	0.0334	0.197	Normal UTL
Thallium	No Tidal Influence Surface soil (0-0.5 feet) samples	6/20	30	0.0775	0.142	NC	NC	0.142	Nonparametric UTL ⁽¹⁾
Thallium	Tidal Influence samples	7/20	35	0.0831	0.103	NC	NC	0.103	Nonparametric UTL ⁽¹⁾
Vanadium	Shallow soil (1-2 feet) samples	30/30	100	16.3	51.6	29.6	9.85	51.5	Normal UTL
Vanadium	Surface soil (0-0.5 feet) samples	30/30	100	8.26	39.9	18	6.61	34.9	Gamma UTL
Zinc	All samples	60/60	100	3.44	416	91	75.6	280	Gamma UTL
Mercury	All samples	60/60	100	0.00463	0.243	0.0579	0.0474	0.191	Gamma UTL
4,4'-DDD	All samples	20/60	33.3	0.001	0.043	NC	NC	0.043	Nonparametric UTL ⁽¹⁾
4,4'-DDE	All samples	15/60	25	0.0014	0.0093	NC	NC	0.0093	Nonparametric UTL ⁽¹⁾
4,4'-DDT	All samples	24/60	40	0.0012	0.03	NC	NC	0.03	Nonparametric UTL ⁽¹⁾
Aldrin	All samples	2/60	3.33	0.0019	0.002	NC	NC	0.002	Nonparametric UTL ⁽¹⁾
alpha-BHC	All samples	1/60	1.67	0.0021	0.0021	NC	NC	0.0021	Nonparametric UTL ⁽¹⁾
alpha-Chlordane	All samples	22/60	36.7	0.0013	0.29	NC	NC	0.29	Nonparametric UTL ⁽¹⁾
beta-BHC	All samples	3/60	5	0.0015	0.0026	NC	NC	0.0026	Nonparametric UTL ⁽¹⁾

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Constituent	Data Set	# Detects/ # Samples	% of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Mean	Standard Deviation	95/95 UTL	Comment
delta-BHC	All samples	5/60	8.33	0.00041	0.0014	NC	NC	0.0014	Nonparametric UTL ⁽¹⁾
Dieldrin	No Tidal Influence samples	14/40	35	0.00092	0.052	NC	NC	0.052	Nonparametric UTL ⁽¹⁾
Dieldrin	Tidal Influence samples	1/20	5	0.0031	0.0031	NC	NC	0.0031	Nonparametric UTL ⁽¹⁾
Endosulfan I	All samples	3/60	5	0.0015	0.0061	NC	NC	0.0061	Nonparametric UTL ⁽¹⁾
Endosulfan II	All samples	2/60	3.33	0.0017	0.007	NC	NC	0.007	Nonparametric UTL ⁽¹⁾
Endosulfan sulfate	Surface soil (0-0.5 feet) samples	6/30	20	0.00076	0.0049	NC	NC	0.0049	Nonparametric UTL ⁽¹⁾
Endrin	All samples	6/60	10	0.00079	0.013	NC	NC	0.013	Nonparametric UTL ⁽¹⁾
Endrin aldehyde	Surface soil (0-0.5 feet) samples	4/30	13.3	0.0022	0.0051	NC	NC	0.0051	Nonparametric UTL ⁽¹⁾
Endrin ketone	All samples	5/60	8.33	0.0012	0.0037	NC	NC	0.0037	Nonparametric UTL ⁽¹⁾
gamma-BHC	All samples	1/60	1.67	0.0014	0.0014	NC	NC	0.0014	Nonparametric UTL ⁽¹⁾
gamma-Chlordane	All samples	27/60	45	0.00081	0.23	NC	NC	0.23	Nonparametric UTL ⁽¹⁾
Heptachlor	No Tidal Influence samples	8/40	20	0.0011	0.013	NC	NC	0.013	Nonparametric UTL ⁽¹⁾
Heptachlor epoxide	No Tidal Influence samples	11/40	27.5	0.00085	0.046	NC	NC	0.046	Nonparametric UTL ⁽¹⁾
2,4-D	All samples	4/60	6.67	0.0024	0.012	NC	NC	0.012	Nonparametric UTL ⁽¹⁾
2,4-DB	All samples	17/60	28.3	0.0024	0.085	NC	NC	0.085	Nonparametric UTL ⁽¹⁾
2,4,5-TP (Silvex)	All samples	3/60	5	0.0023	0.0038	NC	NC	0.0038	Nonparametric UTL ⁽¹⁾
Dalapon	No Tidal Influence Shallow soil (1-2 feet) samples	8/20	40	0.002	0.024	NC	NC	0.024	Nonparametric UTL ⁽¹⁾
Dalapon	No Tidal Influence Surface soil (0-0.5 feet) samples	1/20	5	0.0055	0.0055	NC	NC	0.0055	Nonparametric UTL ⁽¹⁾
Dalapon	Tidal Influence samples	10/20	50	0.0041	0.24	NC	NC	0.24	Nonparametric UTL ⁽¹⁾
Dicamba	All samples	2/60	3.33	0.0078	0.0087	NC	NC	0.0087	Nonparametric UTL ⁽¹⁾
Dichlorprop	All samples	7/60	11.7	0.0027	0.025	NC	NC	0.025	Nonparametric UTL ⁽¹⁾
Dinoseb	No Tidal Influence Shallow soil (1-2 feet) samples	1/20	5	0.018	0.018	NC	NC	0.018	Nonparametric UTL ⁽¹⁾
Dinoseb	No Tidal Influence Surface soil (0-0.5 feet) samples	6/20	30	0.002	0.025	NC	NC	0.025	Nonparametric UTL ⁽¹⁾
Dinoseb	Tidal Influence Shallow soil (1-2 feet) samples	2/10	20	0.0028	0.0031	NC	NC	0.0031	Nonparametric UTL ⁽¹⁾
Dinoseb	Tidal Influence Surface soil (0-0.5 feet) samples	8/10	80	0.0028	0.0067	0.0038	0.00186	0.0092	Normal UTL
MCPP	All samples	15/60	25	0.4	8	NC	NC	8	Nonparametric UTL ⁽¹⁾
1-Methylnaphthalene	All samples	19/60	31.7	0.0018	0.36	NC	NC	0.36	Nonparametric UTL ⁽¹⁾
1,1'-Biphenyl	All samples	7/60	11.7	0.0019	0.016	NC	NC	0.016	Nonparametric UTL ⁽¹⁾
2-Methylnaphthalene	All samples	22/60	36.7	0.0019	0.4	NC	NC	0.4	Nonparametric UTL ⁽¹⁾
Acenaphthene	Shallow soil (1-2 feet) samples	5/30	16.7	0.0029	0.0092	NC	NC	0.0092	Nonparametric UTL ⁽¹⁾
Acenaphthene	Surface soil (0-0.5 feet) samples	19/30	63.3	0.0019	0.042	0.00224	0.0141	0.0464	Lognormal UTL
Acenaphthylene	Shallow soil (1-2 feet) samples	8/30	26.7	0.0023	0.0064	NC	NC	0.0064	Nonparametric UTL ⁽¹⁾
Acenaphthylene	Surface soil (0-0.5 feet) samples	16/30	53.3	0.0036	0.018	NC	NC	0.018	Nonparametric UTL ⁽¹⁾
Acetophenone	Surface soil (0-0.5 feet) samples	10/30	33.3	0.0019	0.014	NC	NC	0.014	Nonparametric UTL ⁽¹⁾
Anthracene	No Tidal Influence Shallow soil (1-2 feet) samples	5/20	25	0.0034	0.078	NC	NC	0.078	Nonparametric UTL ⁽¹⁾
Anthracene	No Tidal Influence Surface soil (0-0.5 feet) samples	14/20	70	0.0028	0.042	0.0116	0.0181	0.055	Normal UTL
Anthracene	Tidal Influence Shallow soil (1-2 feet) samples	8/10	80.0	0.0024	0.026	0.00678	0.0111	0.0392	Normal UTL
Anthracene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100.0	0.0042	0.13	0.0615	0.0399	0.178	Normal UTL
Benz(a)anthracene	No Tidal Influence Shallow soil (1-2 feet) samples	10/20	50.0	0.0029	0.29	NC	NC	0.29	Nonparametric UTL ⁽¹⁾
Benz(a)anthracene	No Tidal Influence Surface soil (0-0.5 feet) samples	19/20	95.0	0.0018	0.32	0.114	0.117	1.22	Gamma UTL

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Constituent	Data Set	# Detects/ # Samples	% of Detects	Minimum Detected Concentration	Maximum Detected Concentration	Mean	Standard Deviation	95/95 UTL	Comment
Benz(a)anthracene	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100.0	0.011	0.26	0.0795	0.0827	0.32	Normal UTL
Benz(a)anthracene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100.0	0.052	0.94	0.544	0.287	1.38	Normal UTL
Benzaldehyde	Shallow soil (1-2 feet) samples	2/29	6.9	0.0022	0.0035	NC	NC	0.0035	Nonparametric UTL ⁽¹⁾
Benzaldehyde	Surface soil (0-0.5 feet) samples	10/30	33.3	0.0022	0.0073	NC	NC	0.0073	Nonparametric UTL ⁽¹⁾
Benzo(a)pyrene	No Tidal Influence Shallow soil (1-2 feet) samples	10/20	50	0.0023	0.36	NC	NC	0.36	Nonparametric UTL ⁽¹⁾
Benzo(a)pyrene	No Tidal Influence Surface soil (0-0.5 feet) samples	18/20	90	0.0017	0.39	0.149	0.152	1.85	Gamma UTL
Benzo(a)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.015	0.33	0.101	0.0972	0.384	Normal UTL
Benzo(a)pyrene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.058	1.3	0.666	0.373	1.75	Normal UTL
Benzo(b)fluoranthene	No Tidal Influence Shallow soil (1-2 feet) samples	10/20	50	0.0044	0.51	NC	NC	0.51	Nonparametric UTL ⁽¹⁾
Benzo(b)fluoranthene	No Tidal Influence Surface soil (0-0.5 feet) samples	18/20	90	0.0036	0.6	0.208	0.226	2.56	Gamma UTL
Benzo(b)fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.017	0.58	0.132	0.17	1	Gamma UTL
Benzo(b)fluoranthene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.083	2.1	1.17	0.662	3.1	Normal UTL
Benzo(g,h,i)perylene	No Tidal Influence Shallow soil (1-2 feet) samples	10/20	50	0.0037	0.23	NC	NC	0.23	Nonparametric UTL ⁽¹⁾
Benzo(g,h,i)perylene	No Tidal Influence Surface soil (0-0.5 feet) samples	15/20	75	0.003	0.29	0.0899	0.145	0.436	Normal UTL
Benzo(g,h,i)perylene	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.015	0.25	0.0839	0.0718	0.293	Normal UTL
Benzo(g,h,i)perylene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.043	1.3	0.559	0.344	1.56	Normal UTL
Benzo(k)fluoranthene	No Tidal Influence Shallow soil (1-2 feet) samples	10/20	50	0.0021	0.25	NC	NC	0.25	Nonparametric UTL ⁽¹⁾
Benzo(k)fluoranthene	No Tidal Influence Surface soil (0-0.5 feet) samples	19/20	95	0.0016	0.35	0.111	0.118	1.2	Gamma UTL
Benzo(k)fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.014	0.19	0.0738	0.0653	0.264	Normal UTL
Benzo(k)fluoranthene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.052	0.99	0.528	0.338	1.51	Normal UTL
Bis(2-ethylhexyl)phthalate	No Tidal Influence Shallow soil (1-2 feet) samples	12/20	60	0.0032	0.26	NC	NC	0.26	Nonparametric UTL ⁽¹⁾
Bis(2-ethylhexyl)phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	20/20	100	0.0044	0.19	0.0563	0.0538	0.185	Normal UTL
Bis(2-ethylhexyl)phthalate	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.012	0.12	0.0509	0.0396	0.166	Normal UTL
Bis(2-ethylhexyl)phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.016	0.47	0.157	0.13	0.536	Normal UTL
Butyl benzyl phthalate	No Tidal Influence Shallow soil (1-2 feet) samples	5/20	25	0.0026	0.061	NC	NC	0.061	Nonparametric UTL ⁽¹⁾
Butyl benzyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	14/20	70	0.0028	0.11	0.00491	0.0439	0.291	Lognormal UTL
Butyl benzyl phthalate	Tidal Influence Shallow soil (1-2 feet) samples	5/10	50	0.0099	0.072	NC	NC	0.072	Nonparametric UTL ⁽¹⁾
Butyl benzyl phthalate	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.0027	0.23	0.0722	0.0648	0.261	Normal UTL
Caprolactam	All samples	2/60	3.33	0.0046	0.0066	NC	NC	0.0066	Nonparametric UTL ⁽¹⁾
Carbazole	No Tidal Influence Shallow soil (1-2 feet) samples	4/20	20	0.0039	0.032	NC	NC	0.032	Nonparametric UTL ⁽¹⁾
Carbazole	No Tidal Influence Surface soil (0-0.5 feet) samples	13/20	65	0.0017	0.048	0.00871	0.0208	0.0586	Normal UTL
Carbazole	Tidal Influence Shallow soil (1-2 feet) samples	8/10	80	0.0025	0.031	0.00491	0.0122	0.0403	Normal UTL
Carbazole	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.0061	0.11	0.0624	0.0377	0.172	Normal UTL
Chrysene	No Tidal Influence Shallow soil (1-2 feet) samples	11/20	55	0.003	0.43	NC	NC	0.43	Nonparametric UTL ⁽¹⁾
Chrysene	No Tidal Influence Surface soil (0-0.5 feet) samples	20/20	100	0.0018	0.43	0.167	0.173	1.9	Gamma UTL
Chrysene	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.016	0.4	0.119	0.124	0.479	Normal UTL
Chrysene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.07	1.6	0.851	0.499	2.3	Normal UTL
Di-n-butyl phthalate	No Tidal Influence Shallow soil (1-2 feet) samples	3/20	15	0.0026	0.0053	NC	NC	0.0053	Nonparametric UTL ⁽¹⁾
Di-n-butyl phthalate	No Tidal Influence Surface soil (0-0.5 feet) samples	14/20	70	0.0024	0.018	0.00392	0.00558	0.0236	Lognormal UTL
Di-n-butyl phthalate	Tidal Influence samples	14/20	70	0.0027	0.02	0.00595	0.0073	0.0234	Normal UTL
Di-n-octyl phthalate	Shallow soil (1-2 feet) samples	2/30	6.67	0.0032	0.022	NC	NC	0.022	Nonparametric UTL ⁽¹⁾
Di-n-octyl phthalate	Surface soil (0-0.5 feet) samples	8/30	26.7	0.0033	0.055	NC	NC	0.055	Nonparametric UTL ⁽¹⁾

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Dibenz(a,h)anthracene	Shallow soil (1-2 feet) samples	10/30	33.3	0.0023	0.12	NC	NC	0.12	Nonparametric UTL ⁽¹⁾
Dibenz(a,h)anthracene	Surface soil (0-0.5 feet) samples	23/30	76.7	0.0026	0.28	0.063	0.104	0.294	Normal UTL
Dibenzofuran	No Tidal Influence samples	10/40	25	0.0016	0.014	NC	NC	0.014	Nonparametric UTL ⁽¹⁾
Dibenzofuran	Tidal Influence Shallow soil (1-2 feet) samples	4/10	40	0.0014	0.0025	NC	NC	0.0025	Nonparametric UTL ⁽¹⁾
Dibenzofuran	Tidal Influence Surface soil (0-0.5 feet) samples	6/10	60	0.0034	0.016	NC	NC	0.016	Nonparametric UTL ⁽¹⁾
Diethyl phthalate	All samples	1/60	1.67	0.0069	0.0069	NC	NC	0.0069	Nonparametric UTL ⁽¹⁾
Dimethyl phthalate	All samples	1/60	1.67	0.0025	0.0025	NC	NC	0.0025	Nonparametric UTL ⁽¹⁾
Fluoranthene	No Tidal Influence Shallow soil (1-2 feet) samples	11/20	55	0.0038	0.63	NC	NC	0.63	Nonparametric UTL ⁽¹⁾
Fluoranthene	No Tidal Influence Surface soil (0-0.5 feet) samples	20/20	100	0.002	0.83	0.247	0.271	3.19	Gamma UTL
Fluoranthene	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.024	0.6	0.138	0.183	1.07	Gamma UTL
Fluoranthene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.12	2.8	1.32	0.813	3.68	Normal UTL
Fluorene	No Tidal Influence Shallow soil (1-2 feet) samples	3/20	15	0.002	0.013	NC	NC	0.013	Nonparametric UTL ⁽¹⁾
Fluorene	No Tidal Influence Surface soil (0-0.5 feet) samples	11/20	55	0.0024	0.012	NC	NC	0.012	Nonparametric UTL ⁽¹⁾
Fluorene	Tidal Influence Shallow soil (1-2 feet) samples	4/10	40	0.0026	0.0064	NC	NC	0.0064	Nonparametric UTL ⁽¹⁾
Fluorene	Tidal Influence Surface soil (0-0.5 feet) samples	8/10	80	0.0025	0.03	0.0125	0.0121	0.0476	Normal UTL
Hexachlorobutadiene	All samples	1/60	1.67	0.0091	0.0091	NC	NC	0.0091	Nonparametric UTL ⁽¹⁾
Indeno(1,2,3-cd)pyrene	No Tidal Influence Shallow soil (1-2 feet) samples	10/20	50	0.0031	0.28	NC	NC	0.28	Nonparametric UTL ⁽¹⁾
Indeno(1,2,3-cd)pyrene	No Tidal Influence Surface soil (0-0.5 feet) samples	17/20	85	0.0026	0.37	0.134	0.136	1.69	Gamma UTL
Indeno(1,2,3-cd)pyrene	Tidal Influence Shallow soil (1-2 feet) samples	9/10	90	0.019	0.37	0.0945	0.111	0.417	Normal UTL
Indeno(1,2,3-cd)pyrene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.056	1.6	0.668	0.417	1.88	Normal UTL
Naphthalene	All samples	19/60	31.7	0.0016	0.11	NC	NC	0.11	Nonparametric UTL ⁽¹⁾
Phenanthrene	No Tidal Influence Shallow soil (1-2 feet) samples	7/20	35	0.0026	0.3	NC	NC	0.3	Nonparametric UTL ⁽¹⁾
Phenanthrene	No Tidal Influence Surface soil (0-0.5 feet) samples	16/20	80	0.0019	0.35	0.062	0.127	0.365	Normal UTL
Phenanthrene	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.0073	0.13	0.0413	0.0405	0.294	Gamma UTL
Phenanthrene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.035	0.69	0.362	0.228	1.03	Normal UTL
Phenol	All samples	1/60	1.67	0.002	0.002	NC	NC	0.002	Nonparametric UTL ⁽¹⁾
Pyrene	No Tidal Influence Shallow soil (1-2 feet) samples	12/20	60	0.0019	0.58	NC	NC	0.58	Nonparametric UTL ⁽¹⁾
Pyrene	No Tidal Influence Surface soil (0-0.5 feet) samples	20/20	100	0.0013	0.63	0.206	0.215	2.54	Gamma UTL
Pyrene	Tidal Influence Shallow soil (1-2 feet) samples	10/10	100	0.019	0.4	0.115	0.128	0.792	Gamma UTL
Pyrene	Tidal Influence Surface soil (0-0.5 feet) samples	10/10	100	0.089	1.9	1.05	0.616	2.84	Normal UTL

Notes:

(1) Nonparametric UTL computed because 60% or background soil concentrations detected.

NC - not calculated because 60% or fewer detected results